NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 258, Vol. 10] THURSDAY, OCTOBER 8, 1874 PRICE $ PER ANN.

Registered as a Newspaper at the General Post Office.

To PUBLISHERS, Journalists, Barristers, &c.—A Gentleman, long connected with the Press, well educated, a swift Shorthand Writer, and knowing French, seeks ENGAGEMENT as WRITER, TRANSLATOR, Literary Amanuensis, Secretary, or in any respectable capacity. Moderate Terms.—Address C. R., Deacon's, Leadenhall Street; or R. F. O'CONNOR, 321, Vauxhall Bridge Road, S.W.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 25s.; 200 ditto, £2 10s. to £3 10s.; 300 ditto, £4 10s. to £6; 400 ditto, £6 to £8; 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples. £3 10s. 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s.; 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6. RECENT SHELLS: 100 genera, £1; 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c., of J. TENNANT, Mineralogist to Her Majesty 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S., at his residence, 149, Strand, W.C.

GEOLOGY.—Collections of Characteristic Fossils and Rocks for Students preparing for the Examinations, at moderate prices; also Single Specimens, Hammers, Pocket Lenses, Books, and all necessaries, of JAMES R. GREGORY, Geologist, 15, Russell Street, Covent Garden, W.C. Removing in December next to 88, Charlotte Street, Fitzroy Square, W.

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O. order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

Sale by Auction.

SCIENTIFIC AND MISCELLANEOUS PROPERTY.

Mr. J. C. STEVENS will Sell by Auction, at his Great Rooms, 38, King Street, Covent Garden, W.C., on FRIDAY, October 9, at half-past 12 o'clock precisely, Lathes and Tools, Model Engines, Electrical Apparatus, Chemicals, Surgical Instruments, Photographic Apparatus, Graphoscopes, Stereoscopes, and a great variety of Miscellaneous Articles.

On view the morning of sale, and catalogues had.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

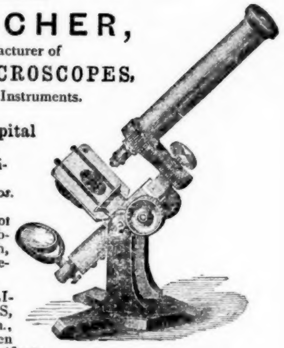
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.



Pillischer's St. Thomas's Hospital Microscope,

As supplied to the principal Universities and Hospitals. Monocular, £5; Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from $\frac{1}{8}$ to $\frac{1}{50}$ inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, $3\frac{1}{2}$ in., 14s.; $4\frac{1}{2}$ in, 17s.; 6 in, in Wooden Case, 10s., including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
,, Double ,, 31s. 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

THURSDAY, OCTOBER 8, 1874

PROFESSOR HUXLEY AT MANCHESTER

PROF. HUXLEY, whose breadth of view at once claims attention for all he utters, has utilised the opportunity afforded him by the opening of the new Medical School at Owens College to call attention to several points the discussion of which at the present time is of the most vital importance.

The rapid growth and increasing importance of Owens College are known to all our readers, and the recent addition of the new Medical School has added still another Faculty to that teaching centre, so that, as Prof. Huxley very properly points out, the College is a University in the old sense in everything but the name. A University in the new sense of course it is not, because it does not yet possess the power of granting degrees. But we imagine that the distinguished men who are directing teaching and research at Owens College can well afford to wait for this privilege, if privilege it be, especially if older foundations set an example of emphasizing this portion of their work to the neglect either of sound practical teaching or the advancement of knowledge which we regard as of still higher importance.

Prof. Huxley, by his approval of the location of the new Medical School side by side with Arts and Science Faculties, has not only brought again to the front the miserable condition of the majority of our Medical Schools, but has called into question the whole policy of Colleges of Science and Institutions for Technical Training. This part of his speech is so important and so connected, and there is so much to ponder over in it, that we give it entire :—

"Your Faculty of Arts speaks for itself; the distinction of many of its members, and the fact that they are authors of works well known and esteemed all over England, and wherever the English language is read, is sufficient to give that Faculty a high position. It certainly would not become me to speak of its operations as if I were a judge of them in any way whatever; but I may be allowed as a person whose pursuits lie elsewhere, and who has the misfortune to be accused sometimes of seeing no merit and desert in anything but his own pursuits, to say that I trust that the position of the Arts Faculty in this institution will never by a hairbreadth or shadow be diminished, but that a sound and thorough training in literature and general knowledge will be regarded henceforward, as very properly it is now, as the essential foundation in the intellectual life of every educated man; and let me say, to no person is such education and such training of greater importance than to us who are called men of science. Our occupations are very engrossing, and they can be pursued with success only by the intensest stress and attention, and we are obliged even to limit ourselves to particular fractions and particular portions of our own study if we are to make any advance therein; and unless we have the good fortune to be trained in early youth to take a broad and general view of the interests of human nature, unless our tastes are disciplined and refined, and unless we are led to see that we are citizens and men before anything else, I say it will go very hard indeed with men of science in future generations, and they will run the risk of becoming scientific pedants when they should be men, philosophers, and citizens. Still less, if possible, can I have anything to say respecting the Faculty of Law, but as regards that of Science, by which, of course, is understood physical science, I can only express my unmeasured satisfaction at the complete—I may almost say magnificent—arrangements provided for the teaching of this subject in this institution. The laboratory of my friend the Professor of Chemistry has, I take it, few parallels; and if the laboratory of my friend the Professor of Physics is not so complete, I am sure it is far better than nine-tenths of such laboratories, and I am certain that those benefactions at which I was looking just now will, before long, enable him to put his establishment on the same footing as to completeness and magnificence as that of his colleague of Chemistry. I understand—indeed I know very well, knowing how much my distinguished friend, Prof. Roscoe, has been in this institution—that he had, I believe, the advantage of being on the spot when the building went on, and although I am sure he is the last man to take any more than his own share, somehow he has got a good deal. But now I come to that which is my proper subject to-day, and that is our Medical School. I have not seen in the course of my experience—I say it deliberately—I have not met with any more efficiently organised institution than you have within the four walls of that Medical School. I have some acquaintance with such institutions, and their interests, and I undertake to say that you will not find better constructed appliances for the teaching of those branches of science which relate to medicine than you will find in that school. Everything has been very carefully considered, and everything has been done which the idea of convenience could suggest, or which efficiency requires to have carried out. Addressing myself now rather to the lay portion of my audience, it may astonish many and puzzle them somewhat to know why so elaborate an apparatus is needed for the teaching of medicine, and why men require to spend so long a period of arduous study in that most important of pursuits. I believe this surprise arises from the prevalence in the general mind of the notion which was once exceedingly common in the philosophical mind, that the human body in general is dependent upon forces and powers which are altogether different from those we find working in other kinds of matter. It is not 200 years since the notion existed that the vital processes of the body were subject to some demon, who kept the body straight, I suppose when in good temper, and let it go wrong when out of sorts; and when it was gravely supposed that there was a broad gulf between the phenomena of inorganic nature and those of life. Now let me say this, that the whole of our modern scientific study of medicine depends upon precisely the contrary assumption —upon the assumption that the living body is a mechanism infinitely more refined, and infinitely more difficult to understand, than our coarse human machinery, but still a mechanism governed by rules and laws which can be discovered and which can be applied and reasoned from, in order to understand its processes. Modern medicine, in fact, is a kind of engineering. It is the attempt to understand the machinery of the body for the purpose of being able to put it right when it goes wrong. I have seen in your great factories in Manchester some of those astonishingly complicated pieces of machinery which seem almost endowed with life, by which the products which make Manchester so famous are produced. Let me put before you the case of the possessor of one of those machines, who, finding that it has gone wrong and that it will not work properly, finds himself, as Sir Robert Peel would have said, with three courses open to him—either that he might sit down and hope that it would get better, and perhaps even offer up his prayers that it might get better; or who should send to the nearest blacksmith and tell him to bring his hammer and bottle of oil, and tap here, or oil there, in the chance of setting the machine right; or should, thirdly, send for some skilled and experienced mechanic who from long study and familiarity with it would be able to judge by the mode of action where it was wrong, and be able to put his finger on the part which

was broken or injured, and thus be able to set it right. Now, the human body is a machinery which, in complexity, stands to the spinning jenny in the same relation as the spinning jenny stands to a child's windmill. But it stands by the same laws, and those who have to deal with it must be guided by the same reasoning. Sickness is the going wrong of the machinery. Death is the destruction of part of the machinery, and the only way in which that machinery can be set right, if it goes wrong, is not by sitting down and hoping for it, and it is not by sending for the first blacksmith who will administer his purge here and his bleeding there, and who is what we call a 'quack.' I mean a person who is really ignorant of that with which he is dealing, and who yet, nevertheless, presumes to meddle with it. That is the essence of quackery. Or, thirdly, we must send our skilled engineer, who, by the help of what he calls symptoms, finds out what wheel is out of place, what cog is broken, and by his previous knowledge of therapeutics knows in what way it is possible to get this erring wheel or broken pinion into its place again. And it is in order that we may have such skilled engineers to the body that all this great apparatus which you see erected here, and all this long period of study is carried out. I do not know anything which strikes me more forcibly than the progress which this kind of knowledge has made within the last thirty or forty years. . . . I happened to take up to-day the syllabus of your sessional work here, and I turn, not unnaturally, to the class of Practical Physiology and Histology, and on looking over the various doings of this course of instruction, it struck me that thirty years ago, when I began my medical studies, there certainly was nobody in London—nay, nobody in the world—who could have given you this course of instruction. We had not the instruments which are necessary to carry it out. The whole course of medical study since that time has been completely changed—in the first place, by discoveries made by the use of the microscope, and, in the second place, by that application of delicate instruments to the illustration of the mechanism of the body, which is the very essence and a great part of modern physiology. At that time even organic chemistry was hardly in existence. It is this recognition of the fact that the study of life is essentially a question of applied physics and chemistry which has changed the whole course of our medical studies. It is that which makes elaborate appliances necessary.

The main question raised by Prof. Huxley in these remarks is, in our opinion, really this: Are we in the future to mass our Faculties as they are massed in Germany, or are we to separate them as they are separated in France?

The altogether glorious mental activity of the Germans in the present century is undoubtedly due to the commingling of the teaching of the various Faculties, and to the University teaching universally available. In Germany it may be said that there are no provincial institutions, for the smallest universities are modelled on the largest, and are as perfect, so far as they go. The metropolis is thus carried into the provinces.

Contrast this with the condition of things in France, with its single University and special scientific schools, and where outside Paris there is no institution, so far as we are aware, where all the Faculties exist side by side, and are conducted with equal vigour. Medical Faculty here, Law Faculty there, Arts Faculty somewhere else, and Science Faculty again in another region; such is the condition which is now being severely criticised by many of the best minds in France. But it must be remembered that while the whole of France besides Paris is so lamentably provincial, in Paris itself there are facilities for advancing and dis tributing knowledge which put London *plus* Oxford and Cambridge to shame.

In provincial England we fear it may be said with too much truth that we are at the present moment behind France. It is clear that in Owens College we have an institution which will correct the existing condition of things on the German plan; in such institutions as the Yorkshire College of Science we have attempts to correct it on the French plan, a plan condemned utterly by the most far-seeing men in France itself; while we have not in England the corrective supplied by Paris, considered as a vast centre of teaching and research.

We are glad that Prof. Huxley has called attention to the importance of the step taken by Manchester, and has so clearly stated his idea of the right thing to be done for the advancement of the higher education.

Nor did he neglect to point out the intimate connection that must exist between this and the secondary education before any real progress can be made :—"You who commence your medical studies should come prepared with the outlines of physics and chemistry as your foundations. One of the great reasons of the backwardness of medical study is that those who come to study are, by reason of the lamentable defects of their common school education, utterly unprovided with a knowledge of what those physical studies mean. I wish to stamp upon your minds, as firmly and as strongly as it is burnt into my own, that all these appliances and all these mechanical aids for the study of medicine are simply thrown away unless they have the foundation of human hard work and clearheadedness to go upon."

Still another point of the most vital importance to the future progress of Science in this country was touched upon; we refer to Prof. Huxley's statement of opinion as to the importance of the Research Scholarships established at Owens College :—

"I notice in these donations and in these sums of money subscribed for the purpose of building and endowing and providing with scholarships this great institution, what appears to me to be a peculiar feature; at least I know nothing exactly like it anywhere else: and as it appears to me to be a feature of great importance and one which it is desirable to imitate as fast as possible by other educational bodies, you will pardon me if I dilate upon it for a short time. You have two scholarships which differ from the ordinary scholarships in this, that they are rewards not merely for learning, and not merely for careful attention and diligent study of that which the student may learn in the lecture-room or from books, but they are rewards which are given to those who exhibit in some degree that most valuable and most important of all intellectual gifts, the power of advancing truth by the pursuit of original research. I refer to the Dalton Scholarship and the Platt Scholarship. I can conceive no object more important at the present time than that of encouraging original research in science, and the way of doing it, without at the same time doing more harm than good, is one which has come very seriously under my consideration as one of the Royal Commissioners for the Advancement of Science, and I earnestly wish that we could look elsewhere to the solution of that problem by means analogous to those adopted here—I mean to say by private benefactors coming forward with their endowments, which endowments should benefit those only who are engaged in original research. The introduction of scholarships of this kind into the

early life of young men, when it is so important that their attention should be directed to original research, is a new feature in this institution, and permit me to say, however important the institution may be in other respects, I am not sure that it is not one of the most important of its features."

It will be seen that while Prof. Huxley acknowledged the necessity for the endowment of unremunerative research, speaking as a Royal Commissioner, he acknowledged also that there are difficulties which surround the solution of the question. We are glad of this, because if the things were easy it would certainly not require that the machinery of a Royal Commission such as the one now sitting should be set in motion; nor, let us add, would it be worth Prof. Huxley's attention. In the fact that the question is a difficult one we see the best justification for the best minds in the country being brought to bear upon it, and we may safely anticipate a satisfactory solution.

THE REPORT OF THE METEOROLOGICAL COMMITTEE

Report of the Meteorological Committee of the Royal Society for the Year ending December 31, 1873. (London, 1874.)

THE proceedings of the Meteorological Committee of the Royal Society for 1873 are detailed in the above Report. The discussion of the meteorology of the district of the Atlantic Doldrums, known as Square 3, has now been completed, and this piece of work, which the Committee consider may fairly be termed a monograph for the district, will shortly be published. The examination of the eight squares adjacent to Square 3 has already been entered upon. The discussion of the results of Sir J. Ross's Antarctic expedition, from the observations made on board H.M.S. *Erebus* and *Terror* in 1840-43 and H.M.S. *Pagoda* in 1845, has also been completed and published, and is a paper of considerable value. Another good piece of work done by the Office is the examination, at the request of the Astronomer Royal, of the observations bearing on the meteorology of Kerguelen Island for the month of December, the results of which have been forwarded to those who are now stationed there to observe the transit of Venus.

We are glad to see that an increasing regularity in the receipt of the Weather Telegraphic Reports is notified, and we very cordially join in the regret expressed by the Committee that the Post Office authorities have declined to extend the telegraph wires so that a station might be established at Mullaghmore, near Sligo. In consequence of this action or want of action on the part of the Post Office, the Meteorological Office continues to be without daily information along the whole of the important and extended line of coast from Valencia to Lough Foyle. We hope that this blank will soon be filled up, and further, that some arrangement will be entered into by which a constant service will be maintained on the west coasts of these islands, and also at the Head Office in London; for until this be carried out, our system of weather telegraphy must, of necessity, not unfrequently fail to give warning of approaching storms. A comparison has been instituted, as in the three previous years, between the warnings issued and the weather experienced on our coasts, with the general result that the total success of warnings for 1873 was 79·2 per cent. as compared with 80·5 per cent. for 1872. In 1870 and 1871 the percentages of success were 68·4 and 63·7 respectively. The mean of these four years is nearly the same as that of the last two years when the office was under Admiral Fitzroy's management, but it will be observed that 1872 and 1873 show the largest number of successful warnings.

The restoration of Admiral Fitzroy's system of warnings, so far as to announce in the warning-message the probable direction of the apprehended storm, is a step which, we see at p. 51 of the "Report on Weather Telegraphy and Storm Warnings, presented to the Congress at Vienna," was strongly urged by the council of the Scottish Meteorological Society upwards of a year ago. The practical restoration of Fitzroy's system has been effected by the Committee, and the change took effect in March last, with, however, the very decided improvement of employing the drum simply to emphasize the warning given by the cone, instead of denoting, as it did originally, "dangerous winds from nearly opposite quarters successively." The Committee have attempted to assign the degree of probability to a storm announced by signal, thus: "Hitherto it has been found that at least *three* out of *five* signals of approaching storms (force upwards of 8 Beaufort scale, a fresh gale), and *four* out of *five* signals of approaching strong winds (force upwards of 6 Beaufort scale, a strong breeze), have been fully justified." We observe with some interest that the Committee have directed that tentative forecasts should be prepared daily in the office, and compared with the facts experienced subsequently, and that they hope ere very long to be able to afford the public the benefit of the information. For the successful development of the important question of weather probabilities, it will be necessary that the Committee investigate weather changes over a much wider area than is covered by the daily weather charts. In this direction, the reports begun to be received during 1873 from Sweden and Denmark will prove to be of considerable utility; but for the success of the experiment it will be necessary that daily reports be also received from points in the north-west of Russia, and in Germany, Austria, and Switzerland.

The anemometrical returns from Bermuda for four years have been published. These observations, and similar observations made at Sandwich, Orkney, previously published by the Committee, have been discussed by a method which cannot be recommended. The results are worth little, and altogether inadequate to the expense incurred in their discussion. The discussion of no meteorological data at all approaches in difficulty that of wind observations, and it is necessary at the outset to apprehend the difficulties to be overcome.

In several cases the language used in the Report is inexact and tends to mislead. Thus an excess of high winds on the coast of Scotland during 1873, and a deficiency on the coasts further south, are stated to be explained by the circumstance that in 1873 "the paths of the storm centres lay to the northward of the British Isles, so that our stations felt the barometrical and other meteorological disturbances, but were not exposed to the full force of the wind." Now, as is pretty well known among

meteorologists, in previous years the immense majority of British storms have had their centres to the northward of the British Isles. The proximate cause of the peculiar distribution of storms of wind during 1873 lay not in the position of the paths of the storm-centres, but in the manner of the distribution over Great Britain of the steeper barometric gradients of the atmospheric depressions of the storms of 1873 as they swept eastwards over north-western Europe.

It would have been satisfactory if the comparison which has been instituted by the Office between the observations from Valencia, in Ireland, and Angra do Heroismo, in the Azores, had been detailed in the Report, seeing that it is inferred from the result, "beyond the possibility of a doubt, that reports from a station situated at the Azores would be practically useless to the Office in giving early intimation of approaching storms." The grounds of this strongly-expressed opinion on a point of some importance in weather telegraphy, and contrary to the views entertained by not a few meteorologists, ought to have been stated.

In the Committee's Quarterly Weather Report for 1870 the position of the thermometers at each of their seven observatories was described and figured. We hope that in the next Report a detailed account will be given of the position and exposure of the thermometers at the stations from which the daily telegraphic weather reports are sent, in order that meteorologists may judge how far the observations made at these stations might be available in investigating the climate of the British Isles, and in some other meteorological inquiries. This is by many deemed necessary, especially when it is considered that the Office has not hitherto published any mean temperatures from the daily observations made at their telegraphic stations, and some of these stations, particularly in Ireland, are in parts of the British Isles, of whose climate little is yet known.

GEOLOGY AND AGRICULTURE

Applications de Géologie et l'Agriculture, par M. Amédée Burat, Engineer, Professor at the Central School of Arts and Manufactures. (Paris: Rothschild, 1874.)

GEOLOGY is one of the most interesting of modern sciences. Soon after it assumed shape high hopes were entertained as to its value to the farmer: up to the present these hopes have not been realised. And yet the study of geology is most intimately connected with agricultural pursuits. Surface geology deals with the soil which daily occupies the thoughts and labours of the farmer. There is one phase of surface geology which has been almost wholly neglected of late; we refer to the connection between soils and the rock-formations from which soils have been derived. It is here possibly that there is the widest field for original research. It was hoped that this branch of agricultural science would have received much attention from the present secretary to the Royal Agricultural Society of England, who had previously been a diligent student of geology and secretary to the Geological Society. So far, his hands would appear to have been full of other work, and he has done little where much was expected.

That there is a most intimate connection between soils and rock-formations is well known. In some places the soil is the direct product of the disintegration of the underlying rock. It more frequently happens, however, that the soil has not been derived from the rock on which it rests, but consists of drifted material. The study of this drifted material is most interesting to the geologist, and ought to be most instructive to the farmer. It enables the geologist to understand the direction and force of former water-currents; and thus throws light on obscure phenomena. A careful examination of the drift enables us to trace the origin of the soil. Thus, for example, a study of the stones and pebbly particles of the soil, enables us not only to know the rocks from which it was derived, at all events partly, but also to understand the rate at which plant-food may become liberated on the soil by the disintegration of these very stones and pebbles. On this point a word of explanation may be here offered.

If we examine a fertile soil at any time we shall find that only a very small portion of its substance (seldom more than one per cent.) is in a condition fit for nourishing our crops, the great bulk of its substance being locked up in a condition at the moment unavailable. By the action of air, of moisture, of heat, and of manure, part of this unavailable matter becomes available for crops. It is on the rate at which the process of disintegration—or liberation of plant-food—takes place that the *natural* power of production of the soil chiefly depends. The study of agricultural geology from this point of view is manifestly of the highest scientific and practical importance: it opens up a wide field for original research. We had hoped, on receiving M. Burat's little volume, that he would have taken up the subject. We have been disappointed.

The work is, not, however, without merit. The language is simple, and the style as lucid as need be.

In the introduction the author leads the reader to expect a fuller exposition of the relation between geology and practical farming than he will find in the volume. The book contains four chapters. The first is a disquisition, couched in very general terms, on the physical characters and composition of soils. As an illustration of the very general character of the matter we quote the average composition of fertile soils (p. 8):—

Every 100 parts contain—

35	gravelly particles of the size of peas		
45	ditto	ditto	millets
10	ditto	of fine sand	
10	ditto	of fine material, separable by washing.	

We are next furnished with a general "ultimate" chemical composition of an average soil. Information of this kind possesses no value except to the junior student.

The second chapter is devoted to manures, which are treated in a popular manner. The third chapter is on the action of water, and the subject is treated in an interesting manner; the services of the Abbé Paramere are duly acknowledged. The fourth, and last, is the most interesting chapter in the work. Here the author shows very clearly that there is a connection between geology and agriculture, drawing illustrations from the primary, secondary, and tertiary groups of rocks. Soils formed from granitic

rocks are, in Great Britain and Ireland and elsewhere, deficient in lime. In our own experience we have seen most valuable results produced by the application of lime to these soils; and we learn from M. Burat that by the same means several districts in the West of France, which formerly were unable to maintain their people without extraneous supplies of food, have (*i.e.* by the use of lime) become the largest exporters of grain. All the author's illustrations are taken from France, but they have their counterparts in these islands.

On the whole, we are justified in saying that the little work will well repay perusal.

OUR BOOK SHELF

Flora of Dorsetshire. By J. C. Mansel-Pleydell. (London: Whittaker and Co. Blandford: W. Shipp.)

Flora Cravoniensis: or, a Flora of the Vicinity of Settle in Craven, Yorkshire. By John Windsor. (Manchester: Cave and Sever, 1873. Printed for private circulation.)

ALTHOUGH the boundary-lines of our counties are, as a rule, purely arbitrary, it is probably wise for the compilers of local floras to maintain them rather than to erect new ones of their own. The area of their observations is, at all events, thus rendered perfectly clear and certain. Dorset has long been famous for its palæontological wealth, both vegetable and animal; and we have here a record of its living flora, which, as might be expected from its length of sea-board and its variety of geological formations—lias, oolite, forest marble, Oxford clay, coral rag, Kimmeridge clay, Portland sand, Purbeck, chalk, and Eocene—is a rich one. The value of local floras depends greatly on the dependence that can be placed on the determination of the species by the editor and his *collaborateurs;* and on this point it seems to us that the present work can be safely trusted, great pains having been taken to establish the authenticity both of the localities and of the nomenclature. The county is divided into seven districts determined by the drainage, and therefore generally separated by high land; and a very good map of the county accompanies the volume. Among the greatest botanical rarities of the county (some of them almost unique) are—*Polycarpon tetraphyllum*, *Lotus hispidus*, *Simethis bicolor*, *Leucojum vernum* (doubtfully native), *Carex clandestina*, *Scirpus parvulus*, and *Cynodon dactylon*. The flora is confined to flowering plants and vascular cryptogams.

Mr. Windsor's "Flora of Craven" (the veteran author did not live to see its publication, or rather printing) is compiled on a different plan, the area being a somewhat arbitrary one: "about Settle and its neighbourhood to a moderate distance, generally within twelve miles, but in a few instances extending somewhat further." The district is a remarkably interesting one, whether from a geological or a botanical point of view; and the flora has been compiled with as great care as in the other case under notice, with the assistance of several good local botanists, and includes not only the flowering plants and vascular cryptogams, but also the Characeæ, Mosses, Hepaticæ, and Lichens. A district that includes among its native plants such rarities as *Polemonium cœruleum*, *Epipactis ovalis*, and *Cypripedium calceolus*, is of no ordinary interest.

Both these volumes are useful contributions to our library of local botany. We would especially commend to compilers of similar works the plan adopted by Mr. Mansel-Pleydell, of giving the geographical range of each species in the neighbouring counties of England and on the opposite coast of France.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Migration of Birds

THE subject to which Prof. Newton has called attention is one of great interest to all naturalists, and requires to be studied systematically; for I can hardly think that the solution is so "simple in the extreme" as Mr. Newton thinks it may be.

It appears to me probable that here, as in so many other cases, "survival of the fittest" will be found to have had a powerful influence. Let us suppose that in any species of migratory bird, breeding can as a rule be only safely accomplished in a given area; and further, that during a great part of the rest of the year sufficient food cannot be obtained in that area. It will follow that those birds which do not leave the breeding area at the proper season will suffer, and ultimately become extinct; which will also be the fate of those which do not leave the feeding area at the proper time. Now, if we suppose that the two areas were (for some remote ancestor of the existing species) coincident, but by geological and climatic changes gradually diverged from each other, we can easily understand how the habit of incipient and partial migration at the proper seasons would at last become hereditary, and so fixed as to be what we term an instinct. It will probably be found, that every gradation still exists in various parts of the world, from a complete coincidence to a complete separation of the breeding and the subsistence areas; and when the natural history of a sufficient number of species in all parts of the world is thoroughly worked out, we may find every link between species which never leave a restricted area in which they breed and live the whole year round, to those other cases in which the two areas are absolutely separated. The actual causes that determine the exact time, year by year, at which certain species migrate, will of course be difficult to ascertain. I would suggest, however, that they will be found to depend on those climatal changes which most affect the particular species. The change of colour, or the fall, of certain leaves; the change to the pupa state of certain insects; prevalent winds or rains; or even the decreased temperature of the earth and water, may all have their influence. Ample materials must exist, in the case of European birds, for an instructive work on this subject. The two areas should be carefully determined for a number of migratory birds; the times of their movements should be compared with a variety of natural phenomena likely to influence them; the past changes of surface, of climate, and of vegetation should be taken account of; and there seems no reason to doubt that such a mode of research would throw much light on, if it did not completely solve, the problem.

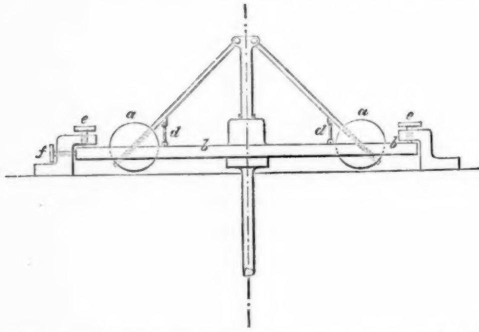
This is an appropriate opportunity for making a suggestion which has long been in my mind. It is, that it would be a valuable and interesting addition to NATURE, if we were supplied with a weekly (or monthly) "Calendar of Periodical Phenomena in Natural History," such as the average dates of appearance and departure of migratory birds, of the opening and fall of the leaf of our forest trees and common cultivated trees and shrubs; of the flowering of our common field and garden plants; and also the mean *highest* and *lowest* temperature of each *day*, the direction of the wind and amount of rainfall for each *week*, according to the Greenwich averages. None of this information is given in the usual almanacks or periodicals, and it is by no means easy to find it when wanted. Yet it is surely of much value to everyone who lives in the country, and would be the means of exciting an intelligent interest in such observations and inquiries as those to which Prof. Newton has called our attention in his interesting article.

ALFRED R. WALLACE

Regular Motion in Clockwork

IN order to ensure perfectly regular motion in the clockwork which drives the revolving dioptric apparatus made by Messrs. Chance, Bros. and Co., I have recently introduced a centrifugal governor, which might perhaps also be useful for the clocks of equatorials. Though it involves nothing new in principle, the form differs from anything I have seen, in that the governor balls have to lift a heavy weight, and that the leather rubbers or brushes are not carried by the revolving balls, but are fixed to the frame of the clock and rub against the disc which forms the extra weight lifted by the balls. The sketch shows the governor

in use on the clock of the apparatus of Cape Bon, Tunis, an apparatus exactly similar to that now standing in the International Exhibition. It consists of a shaft making 170 revolutions per minute, to which the balls *a a* are hung, and on which the disc *b b* can slide, guided by a feather key. When the clock is below speed the disc rests upon a collar fixed on the shaft, the pull exerted by the balls through the links *d d* being insufficient to raise it; but as soon as the proper speed is attained, the disc rises and comes in contact with the screws *e e*, which are tipped with leather and fixed to the frame of the clock. Spaces are cut out of the disc to admit the balls, avoiding unnecessary height. The screw *f* serves as a brake to stop the clock at pleasure. I



calculate that work to the extent of five foot-pounds per minute must be done on the governor to accelerate the clock one second per hour. This form possesses two advantages over that in which the rubbers are carried by the balls—1. It checks any acceleration of the clock more powerfully; 2. It is easier to adjust. In the older form it is necessary to ascertain by careful experiment that *each* ball shall bring its rubber into contact exactly when the speed is correct, whereas in this it is immaterial that the arms of the balls should be exactly equal; it is only needful that they should *together* raise the disc to contact when the speed is right. J. HOPKINSON

Glass Works, near Birmingham, Sept. 1

Rainbows

As a pendant to my note inserted in NATURE, vol. x. p. 437, I may mention that an exceedingly fine lunar rainbow was observed here at 8.40 P.M. on September 29.

Though the moon was near the last quarter, the bow was bright enough to appear reddish on one side and greenish on the other. It is the only one, of some five or six lunar rainbows I have seen, which appeared to show any trace of differences of colour.

I may also mention that about the end of August I saw, two hours after sunrise, a dazzlingly bright and gorgeously coloured parhelion in a small ice-cloud to the right of the sun, the rest of the sky being almost perfectly clear. There had been a sudden and considerable fall of temperature during the previous night.

St. Andrew's, Oct. 2 P. G. TAIT

IN NATURE, vol. x. p. 438, Mr. Schuster complains that in text-books no mention is made of supernumerary rainbows, and that the theory of them is to be sought in original memoirs, not generally accessible. Allow me to mention that in Sir John Herschel's Meteorology (a little work published by Black, price three and sixpence, and originally an article in the Encycl. Britann.), a complete explanation of the rainbow, and of the supernumerary bows as well, on the principle of interference, is to be found. F.M.S.

U.S. Weather Maps

IN Prof. Loomis's "Results of an Examination of the U.S. Weather Maps for 1872 and 1873" (published in the *American Journal of Science and Arts*, and recently noticed in NATURE, I am struck not only by the general agreement but by the almost verbal coincidence of one or two of his "Results" with some of the rules laid down in my work on the "Laws of the Winds prevailing in Western Europe," which was published in the beginning of 1872.

In "Laws of the Winds," Part I. p. 56 and following, I have shown that "we are unable to account for the eastward progress of depressions by attributing it to prevailing westerly upper-currents," but that "each system of depression appears to travel eastward with a kind of self-developed motion," and that the precipitation on the east side of the centre "is the principal agent in producing the change of geographical position." Prof. Loomis writes: "The progress of a storm eastward is not wholly due to a drifting resulting from the influence of an upper-current from the west, but the storm works its way eastward in consequence of the greater precipitation on the eastern side of the storm."

Prof. Loomis also appears to attribute the formation of some depressions, primarily developed in the United States, to the collision of moist air from the Pacific with the mountains in the north and west, in the same way as I have attributed the primary formation of some of our depressions to the collision of the vapour-laden atmosphere from the Atlantic with the high-lands in the west and north of the British Isles.

I am glad to observe that Prof. Loomis is no advocate of the "circular theory" of storms as still held by some meteorologists. He intimates the mean inclination of the wind towards the lower isobars as "more than 45°" in the United States. In the Journal of the Scottish Meteorological Society, No. xxxix. I have shown that at stations in the British Isles the mean inclination is 21°, but that it appears to be considerably higher in continental Europe.

In the work previously alluded to I have shown that depressions appear to travel most to the south when the atmosphere is warmer in the west than in the east, and most to the north under contrary circumstances, but that this influence is interfered with by another, viz., the tendency of depressions to travel so as to have the highest general pressures on their right. A less limited acquaintance even than I can claim with the U. S. Weather Maps would go far to show which of these two influences is the predominant, the general atmospheric conditions of the United States presenting a better field for their investigation than is to be obtained in Europe. Prof. Loomis finds that in North America storms tend most to the south in July and to the north in October. It would be interesting to inquire whether this observation holds good of depressions on the Pacific coast, as well as near the Atlantic. But a two years' average is insufficient to settle such questions.

On the whole it is satisfactory to find that some important results obtained from a study of European weather-charts are found, on good authority, to be in accordance with those derived from the U.S. maps. At the same time some of the theoretical remarks made by Prof. Loomis will not, I think, be generally endorsed by meteorologists. The statement that "it needs no argument to prove that when the wind is flowing from all quarters inwards upon a central area, there is a rapid accumulation of air, which can only escape by an upward motion," is incorrect; the depression of the barometer in the centre showing that there is no accumulation, but a rarefaction, produced in part, as Prof. Loomis has himself previously shown, by precipitation, and which is itself the cause of the influx.

Under the present conditions of anemometry all endeavours to calculate the upward movement in a storm from anemometrical data should also be accepted with much reserve. Still more hazardous (considering the inclination of depression-axes and the frequent difference of direction between currents at small and those at great elevations) is the attempt, in such an inquiry, to correct the observed velocities at sea-level by those on the summit of Mount Washington. With a depression in Eastern Canada a west wind not uncommonly blows on Mount Washington while more southerly airs are felt at the three nearest stations. If in such a case we calculate the amount of influx towards the depression-centre simply from the ratio between the velocity at sea-level and that on Mount Washington, it is obvious that the result will be the reverse of accurate.

Aug. 25 W. CLEMENT LEY

Aurora

ON Sept. 11 I was at Kyle Akin (Skye). The day had been wet and stormy, but towards evening the wind fell and the sky became clear. About 10 P.M. my attention was drawn to a beautiful auroral display. No crimson or rose tint was to be seen, but a long low-lying arc of the purest white light wa

formed in the north, and continued to shine with more or less brilliancy for some time. The arc appeared to be a double one, by the presence of a dark band running longitudinally through it. Occasional streamers of equally pure white light ran upwards from either end of the bow. The moon was only a day old, but the old landscape was lighted up as if by the full moon; and the effect of Kyle Akin lighthouse, the numerous surrounding islands, and the still sea between, was a true thing of beauty, forming as it did a quiet contrast to the more brilliant but restless forms of auroræ generally seen. I particularly noticed a somewhat misty and foggy look about the brilliant arc, giving it almost a solid appearance. The space of sky between the horizon and the lower edge of the arc was of a deep indigo colour, probably the effect of contrast.

I regretted I had no spectroscope with me, as it would have been a fine opportunity to test the spectrum of an aurora of pure white light. I had a strong impression that the bow was near to the earth, and almost thought that the eastern end, and some fleecy clouds in which it was involved, were between myself and the peaks of some distant mountains. The eye is, however, deceptive in such cases, though instances are not wanting of auroræ close to the earth's surface. I shall be glad to know if other observations of this aurora were made.

Nairn, N.B., Oct. 3 J. RAND CAPRON

The Cry of the Frog

THE fact that the common frog (*Rana temporaria*) is capable of crying out lustily when he feels himself in danger, does not seem to have been frequently remarked. In my small walled garden there is a common frog who is persecuted by three cats. His residence is a heap of slates at the foot of an ivied wall, and here he is safe. But if he ventures far abroad his tormentors soon espy him, and though they seem nearly as much terrified as himself, they cannot resist the temptation to touch him with their paws. He immediately opens his mouth and utters a prolonged cry, which appears to be very surprising to the cats, who draw back for a few moments, and then pat him again, apparently out of mere curiosity, to be again scared by the same unusual sound. This sound is a shrill and rather sibilant wail, like the note of a small penny trumpet or the cry of a new-born infant. There can be no mistake about it, as I have repeatedly touched the frog with my own hand after driving the cats away, and the same cry has immediately followed, the lower jaw being dropped so that the mouth stands open about a quarter of an inch at the tip.

Leicester, Sept. 26 F. T. MOTT

The Woolwich Aëronautical Experiment

II.

IN order to discover the laws of the vertical motion, we must suppose that the balloon is resting in perfect equilibrium when on land; which means that the ascending power of the gas enclosed in the balloon is just equal to the weight of the canvas, netting, grapnel, ballast, passengers, &c. Under these circumstances the balloon will not ascend by itself, but it will with all the weight of the sand which may be thrown overboard, if a certain space is left for dilatation and the balloon is not quite full when resting on land. If the volume is V at the surface of earth, it will be $\frac{V H}{h}$ at an altitude where barometric pressure is h, being H at departure. When the balloon is quite full, gas escapes by the lower part under the shape of a whitish steam. If v is the additional volume which can be filled by dilatation, that phenomenon will take place at an altitude where the pressure is h given by the equation $\frac{V H}{V + v}$:

We suppose that the height h is never to be attained, and in fact it is desirable for the aëronauts to limit their altitude before starting, and not to fill their balloon with a gas which they are obliged to throw away by the valve or to see escaping by the *appendice* at some risk of their own safety; one of the greatest advantages of the vertical fan being to limit at will the ascent, as will be shown.

In our calculations we suppose that the canvas is not losing gas, that the sun is not affecting the balloon, and that no water is falling upon it, or no cloud concealing the sun. All these changes of temperature can be made the subject of special calculations, and the real motion of the aërostatic globe is the *mean* between all the different circumstances of the atmosphere.

If a balloon starts in an homogeneous air because a weight p of sand was thrown overboard, P being the weight of the air displaced by the balloon when resting on land, the motive power is $g' = \frac{g\,p}{P + p}$ and the laws of the motions of an Attwood machine are perfectly applicable to it.

The elevation takes place with an increased velocity up to the moment where the resistance of the air is = to g'. Consequently,

$$K v^2 = \frac{p\,g}{P + p}.$$

K being a certain coefficient which depends on the form of the balloon, its diameter, its netting, and the density of the air. K diminishes as the altitude increases, but the diameter of the balloon enlarges gradually to its utmost. As the law of diminution of pressure is not known, we are obliged to suppose $K =$ constant.

If we suppose a balloon of 60,000 cubic feet holding 50,000 cubic feet of gas when resting on the ground, the balloon can reach without losing gas (except by the loss through the canvas, which we suppose to be perfectly gas-tight) to a level where $h' = \frac{5\,h}{6}$ = about 6,000 feet in round numbers. Under these circumstances the weight of the balloon when resting on land may be supposed to be about 3,300 pounds.

If we suppose 20 lbs. of sand are thrown overboard in ascending, the motive power will be $\frac{g}{115}$. The uniform motion will be $K v^2 = \frac{g}{115}$.

Under these circumstances, as far as my knowledge goes, it is 4 ft. per second. If we suppose $g = 32$ feet.

$$K v^2 = 16\,K = \frac{32}{115} \text{ and } K = \frac{32}{115 \times 16} = \frac{2}{115}$$

If a static effort of 20 lbs. in the vertical direction can be produced by the working of the vertical fan, it is easy to understand that the ascent can be stopped before the balloon has reached the level where the gas is beginning to escape by working in the proper direction for it. That effort is not too much for two men working on a fan which is suitably constructed.

The same thing can be said as to the descent of the balloon, but K is much larger, as the shape of the lower part is not so well suited for moving in the air as the upper half. With *appendice*, netting, ropes, and car, it exerts a resistance which is much larger and may be compared with the force exerted by a *parachute* descending in the air. The difference is very great, as I observed several times in my ascents that it was difficult to give the balloon a descending impulsion towards the land. I should not wonder if it was partly the cause of the resistance felt by Mr. Bowdler when moving his fan in the direction where it ought to have caused the balloon to descend; at least such is the opinion that I am in position to hold from the concise and imperfect narrative I found in the public papers.

W. DE FONVIELLE

Is the Rabbit Indigenous?

WOULD you permit me, through the medium of NATURE, to ask on what grounds the rabbit is considered not indigenous in this country? The best authorities on British and German Mammalia seem agreed that it is a native of the Mediterranean basin. On what facts or writings is this opinion based, and at what time was it introduced into Great Britain? I am very anxious to determine whether the above statements are founded on authentic documents or writings, or are merely suppositions which cannot be asserted with certainty. N.

Sept. 30

THE SOCIAL SCIENCE CONGRESS

THE friends of social science have had a most successful meeting this year at Glasgow, and in the various addresses and papers there has been afforded ample evidence that the importance of the introduction of more scientific knowledge into the heads and daily life of the people is becoming more and more widely acknowledged.

In the Health Section, Dr. Lyon Playfair in his address,

after referring to Franklin's aphorism, "Public health is public wealth," pointed out that taking the smallest part of the money saving, it is obvious that money judiciously spent in sanitary improvement is not unproductive taxation, but capital bearing abundant interest; and he then gave an idea of the present sanitary chaos. "In England, at the present time, there is a casual agglomeration of 1,500 separate sanitary authorities, without system or cohesion. Their areas of administration are diverse in the extreme, being neither bounded by counties, parishes, nor natural watersheds; and their duties are divided without meaning between authorities in the same district. They have been lately put under medical officers of health without preparation or qualifications for their duties, some well paid and devoting their time to this important work, others having little more than nominal payment, and giving little more than nominal time to their important duties. Notwithstanding this too sudden and unprepared universal appointment of medical officers, yet in the administration of the Health Acts there has been recently manifested a disposition to 'distrust the doctors,' and to work the Acts, at least at head-quarters, by lawyers and other persons not connected with the medical profession. This is the old error of making common sense the fetish for worship, which Archbishop Whately and others have so effectively condemned. Even the most fervent worshipper of common sense as opposed to technical training never relies on it in important emergencies of his life. He goes to the lawyer to make his will or to convey property; he consults the parson on religious doubts when on the sick bed, and he does not spurn the doctor to cure him of his grievous ailment. But it is well known that the Local Government Board are afraid of the doctors in the administration of Health Acts. Who beside them possess the knowledge? I can testify, from an experience of thirty years in sanitary work—and impartially, because I am not in the medical profession—that there is not a class of men in the country who labour so zealously for the prevention of disease as the doctors, though their training hitherto has been cure, not prevention. Certainly their private interests have never been allowed to stand in the way of their efforts to uproot disease, although their living depends upon its existence. This unselfishness in the application of their science to prevention has always been to me a source of high admiration. Why, then, is there this vulgar distrust of the doctors in the administration of our Health Acts? Extend this prejudice against technical knowledge, and how absurd it would be. Would you improve the progress of telegraphy in this country by suppressing electricians, or the law and justice of the country by putting down lawyers? Would the Secretary at War promote the conduct of war by suspecting soldiers, or the First Lord of the Admiralty the efficiency of fleets by distrusting sailors? Would our railroads and harbours be better governed if engineers were held at a discount? But this is actually the state of things at the Local Government Board—the Health Ministry of the country. The Privy Council handed over to that Board Dr. Simon and his associates, with a wealth of medical experience in public hygiene. Ever since, that wealth has been locked away from public use. Certain I am that their experience could not have guided the Board in the utter confusion of organisation in regard to medical officers of health. They have been appointed without any system. Some have a small parish to attend to, others have a thousand square miles. The last are appointed for combined districts, but are managed by uncombined authorities, and have neither assistants to aid them nor power to enforce their decisions. The officers of health are without any definite rule for obtaining available knowledge of prevailing sickness, even when it is treated at the public expense within their own districts; and they are not, universally at least, informed of the deaths as they occur. The medical officers of health have been appointed without any examination on their knowledge of State medicine, and in the majority of cases they do not possess this knowledge. I am perfectly certain that this utter confusion could not have resulted had the Local Government Board consulted the experienced State medical officers belonging to them. This distrust of the doctors in higher administration is simply a general mistrust of science. And the time has now arrived when science must be trusted in government. Science is entering into the higher education of the country, and the prejudice against it among legislators, who were educated in classical universities, will in time be removed. For the progress of a country depends upon the progress of science, and the welfare of a nation is secured by the most intelligent application of science to its manufactures and to its government. The health of the country—and that governs the productive power of its people—depends as much upon the application of medical science as the working of a machine depends upon a good application of mechanical laws. To trust the whole administration of Health Acts to Poor-law inspectors and lawyers is an amazing example of unbelief in the first principles of the laws of health. The well-being of the people depends upon physical causes, which, when intelligently understood, mean physical science, and the trained physician is the natural and most intelligent agent for extending its knowledge and application to the prevention of disease. What we want in the future is not new law, but more efficient administration of existing law. To heap up new sanitary law on the decaying mass of undigested sanitary law, which already forms a dismal agglomeration, is like the practice of our ancestors, who thought that a few clean rushes thrown upon the corrupt mass of foul rushes on the floor sufficed for sanitary purposes. What we want is superior organisation and efficient administration of existing law. But, in our happy-go-lucky style of government, are we likely to get it? I doubt whether it will be wise to continue the Local Government as a separate department of the State. Its functions in reality appertain to the Home Office, which, when properly organised, should divide itself into two great departments, the one dealing with police and justice, the other with the physical interests of the people. One Secretary of State might have the supreme responsibility, but each of the divisions should be scientifically administered. It would be as absurd to put a man trained in physical science at the head of the branch of police and justice, as it is to put a man merely trained in law in charge of the physical interests of the people. It is an exploded fallacy that only lawyers are good men of business, and that scientific men are not. Is my friend Sir John Lubbock a worse banker because he is an eminent man of science? Is Mr. Spottiswoode a worse printer because he has distinguished himself as a physicist? Is Mr. Warren De la Rue a worse stationer because he is equally conspicuous as an astronomer and as a chemist? The Local Government of the country, in as far as it relates to the physical interests of the people, will remain an example of arrested development, unless science receives a recognised position in its administration."

In the Education Section there was nothing to call for notice in the address, but Mr. C. S. Parker drew attention to the Report of the Universities Inquiry Committee, and an interesting discussion followed.

The revenues of Oxford and Cambridge were reported by the Royal Commission appointed on the advice of Mr. Gladstone to be for the University, Colleges, and Halls of Oxford, 414,000*l*., or, including prospective increase in the next fifteen years, 538,000*l*.; and for the University and Colleges of Cambridge, 340,000*l*., or, including prospective increase, 380,000*l*. Making certain deductions from these totals, the net income was for Oxford 350,000*l*., and for Cambridge 300,000*l*.; or, deducting again what was levied by taxation from their own members, the net endowments for Oxford and Cambridge Universities re-

spectively were 300,000*l.* and 250,000*l.* The largest item of expenditure was to Fellows of Colleges—Oxford, 102,000*l.*; Cambridge, 103,000*l.* The smallest item was for scientific institutions, being under 2,000*l.* for each University. Mr. Parker remarked that this was hardly what might have been expected by the general public. A satirical person might even suggest as an improvement the reversal of the order. Seriously, the distribution came to this. Taking the residents in the University at about 400 graduates and 1,400 undergraduates, almost all the former and about half the latter received substantial aid from endowments. Mr. Parker examined various schemes which had been put forward, and expressed an opinion that, provided the central life were maintained with vigour, it was much to be desired that the Universities should occupy themselves with extending their connections throughout the country. Looking to their examinations in every quarter, 44,000*l.* at Oxford or 33,000*l.* at Cambridge was by no means excessive for Scholarships and Exhibitions. Some Exhibitions should be separately competed for by the unattached students who were now pursuing their studies at the Universities with so much success and at so little expense—in many cases under 50*l.* a year. To carry out needed reforms some central guidance would be necessary, either from a body appointed by the Universities themselves or, more probably, from a Parliamentary Executive Commission. But if such a Commission should be appointed, it was desirable the public should understand that it had not to deal with a retrograde, obstinate, or lethargic corporation, but to cooperate with the Universities and Colleges. Oxford and Cambridge, in respect of learning, had not held their own against the great German Universities, but a change had begun, and in Mr. Parker's opinion they were yearly commanding more respect throughout Europe.

In the discussion which followed, the Hon. G. Brodrick deprecated an attempt to subsidise, at the expense of Oxford and Cambridge, wealthy towns which, had they existed in America, would long ago have provided Universities of their own. On no account should resources which ought to be concentrated upon Oxford be frittered away upon the great cities of England and Scotland.

Sir G. Campbell said that in his belief it was these endowments which seemed to render reform impossible. They acted as an immense bribe to a continuance of the old monkish form of education, which he believed to be a mere superstition. He believed that the devotion of the time and talent of our youth to the learning of the regular verbs of Greek and Latin, and even the higher mathematics, was a gymnastic, and not a practical education. If endowments were to be continued, they must be taken in hand and, apart from the wills of founders, devoted to those branches of education which experience showed to be really useful and practical.

An important paper On the place of technical education was presented to the Section by Mr. B. Samuelson, M.P. This we shall give on a future occasion.

*PITCHER-PLANT INSECTS**

THE insect-catching powers of these curious plants, the Fly-traps (Dionæa), the Sundews (Drosera), and the Trumpet-leaves (Sarracenia), have always attracted the attention of the curious, but renewed interest has been awakened in them by virtue of the interesting experiments and observations on their structure, habit, and function, that have lately been recorded, and especially by the summing up of these observations in some charming papers by Prof. Asa Gray, which recently appeared in the *Nation* and the *New York Tribune* under the title of "Insectivorous Plants."

Through the courtesy of Dr. J. H. Mellichamp, of Bluffton, and of H. W. Ravenel, of Aiken, S.C., who have sent me abundant material, I am able to submit the following notes of an entomological bearing on the Spotted Trumpet-leaf (*Sarracenia variolaris*), which must henceforth rank with the plants of the other genera mentioned as a consummate insect catcher and devourer.

The leaf of Sarracenia is, briefly, a trumpet-shaped tube with an arched lid, covering, more or less completely, the mouth. The inner surface, from the mouth to about midway down the funnel, is covered with a compact decurved pubescence which is perfectly smooth and velvety to the touch, especially as the finger passes downward. From midway it is beset with retrorse bristles, which gradually increase in size till within a short distance of the bottom, where they suddenly cease, and the surface is smooth. There are also similar bristles under the lid. Running up the front of the trumpet is a broad wing with a hardened emarginate border, parting at the top and extending around the rim of the pitcher. Along this border, as Dr. Mellichamp discovered, but especially for a short distance inside the mouth, and less conspicuously inside the lid, there exude drops of a sweetened, viscid fluid, which, as the leaf matures, is replaced by a white, papery, tasteless, or but slightly sweetened sediment or efflorescence; while at the smooth bottom of the pitcher is secreted a limpid fluid possessing toxic or inebriating qualities.

The insects which meet their death in this fluid are numerous and of all orders. Ants are the principal victims, and the acidulous properties which their decomposing bodies give to the liquid doubtless render it all the more potent as a solvent. Scarcely any other Hymenoptera are found in the rotting mass, and it is an interesting fact that Dr. Mellichamp never found the little nectar-loving bee or other Mellifera about the plants. On one occasion only have I found in the pitcher the recognisable remains of a Bombus, and on one occasion only has he found the honey-bee captured. Species belonging to all the other orders are captured, and among the other species that I have most commonly met with, which, from the toughness of their chitinous integument, resist disorganisation and remain recognisable, may be mentioned *Asaphes memnonius* and *Euryomia melancholica* among Coleoptera, *Rentatoma higens* and *Orsilochus variabilis*, var. *complicatus*, among Heteroptera; while kyatids, locusts, crickets, cockroaches, flies, moths, and even butterflies, and some Arachnida and Myriapoda, in a more or less irrecognisable condition, frequently help to swell the unsavoury mass.

But while these insects are decoyed and macerated in order, as we may naturally infer, to help to support the destroyer, there are, nevertheless, two species which are proof against its siren influences, and which, in turn, oblige it either directly or indirectly to support them.

The first is *Xanthoptera semicrocea* Guen., a little glossy moth, which may properly be called the Sarracenia Moth. It is strikingly marked with grey-black and straw-yellow, the colours being sharply separated across the shoulders and the middle of the front wings. This little moth walks with perfect impunity over the inner surface of the pitcher, which proves so treacherous to so many other insects. It is frequently found in pairs within the pitchers soon after these open, in the early part of the season or about the end of April. The female lays her eggs singly, near the mouth of the pitcher, and the young larva, from the moment of hatching, spins for itself a carpet of silk and very soon closes up the mouth by drawing the rims together and covering them with a delicate, gossamer-like web, which effectually debars all small outside intruders. It then frets the leaf within, commencing under the hood and feeding downward on the cellular tissue, leaving only the epidermis. As it proceeds the lower part of the pitcher above the putrescent insect collection becomes packed with ochreous excrementitious droppings, and by the time the worm has attained its full size the pitcher above these droppings generally collapses. This worm when full grown is beautifully banded transversely with white and purple or lake red, which Dr. Mellichamp poetically likens in brightness to the Tyrian dye. It is furthermore characterised by rows of tubercles, which are especially prominent on the four larger legless joints. It is a half looper, having but six prolegs, and keeps up, in travelling, a constant restless, waving motion of the head and thoracic joints, recalling *paralysis agitans*. The chrysalis is formed in a very slight cocoon, usually just above or within the packed excrement. The species, kindly determined by Mr. A. R. Grote, was many years ago figured by Abbott, who found it feeding on *Sarracenia variolaris*, in Georgia. Guenée's descriptions were made from these figures, for which reason I append [the more technical matter relating to the species is here omitted] a few descriptive notes from the living material. It feeds alike on *S. variolaris* and *S. flava*, and there are two broods each year,

* A paper read by Prof. C. V. Riley, of St. Louis, Mo., before the American Association for the Advancement of Science, August 1874.

the first brood of larvæ found during the early part of May, the second toward the end of June, and disappearing with the dying of the leaves, the latter part of July.

The second species is a still more invariable living accompaniment of both kinds of Sarracenia mentioned. By the time the whitish efflorescence shows around the mouth of the pitcher, the moist and macerated insect-remains at the bottom will be found to almost invariably contain a single whitish, legless, grub or "gentile," about as large round as a goose-quill, tapering to the retractile head, which is furnished with two curved, black, sharp hooks, truncated and concave at the posterior end of the body.

This worm riots in the putrid insect remains, and when fed upon them to repletion bores through the leaf just above the

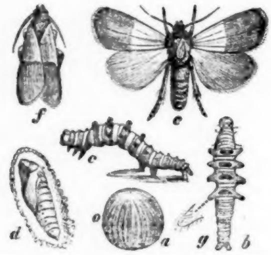


FIG. 1.—*Xanthoptera Semicrocea.* *a*, egg, enlarged, the natural size indicated at side; *b*, *c*, larva, back and side views; *d*, chrysalis: *e*, moth, normal form, with wings expanded; *f*, pale variety with wings closed.

petiole and burrows into the ground. Here it contracts to the pupa state, and in a few days issues as a large two-winged fly, which I have described in the Transactions of the St. Louis Academy of Science as *Sarcophaga sarraceniæ*—the Sarracenia Flesh-fly.

The immense prolificacy of the Flesh-flies, and the fact that the young are hatched in the ovaries of the parent before they are deposited by her on tainted meat and other decomposing or strong-smelling substances, have long been known to entomologists, as has also the rapid development of the species. The viviparous habit among the Muscidæ is far more common than is generally supposed, and I have even known it to occur with the common house-fly, which normally lays eggs. It is also possessed by some Œstridæ, as I have shown in treating of *Œstrus ovis*, the Sheep Bot-fly.

But the propensity of the larvæ for killing one another and their ability to adapt themselves to different conditions of food supply are not sufficiently appreciated. I have long since known, from extensive rearing of parasitic Tachinidæ, that when, as is often the case, a half-dozen or more eggs are fastened to some

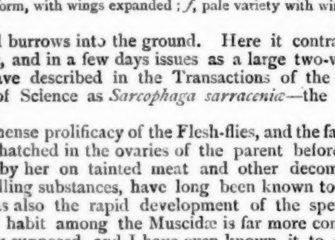


FIG. 2.—*Sarcophaga Sarraceniæ.* *a*, larva; *b*. pupa; *c*, fly, the hair lines showing average natural lengths; *d*, enlarged head and first joint of larva, showing curved hooks, lower lip (*g*), and prothoracic spiracle; *e*, end of body of same, showing stigmata (*f*) and prolegs and vent; *h*, tarsal claws of fly with protecting pads; *i*, antenna of same. All enlarged.

caterpillar victim only large enough to nourish one to maturity, they all hatch and commence upon their common prey, but that the weaker eventually succumb to the strongest and oldest one, which finds the juices of his less fortunate brethren as much to his taste as those of the victimised caterpillar. Or, again, that where the food-supply is limited in quantity, as it often is and must be with insects whose larvæ are parasitic or sarcophagous, such larvæ have a far greater power of adapting themselves to the conditions in which they find themselves placed, than have herbivorous species under like circumstances.

Both these characteristics are strongly illustrated in *Sarcophaga sarraceniæ*. Several larvæ, and often upwards of a dozen, are generally dropped by the parent fly within the pitcher; yet a fratricidal warfare is waged until usually but one matures, even where there appears macerated food enough for several. And if the Xanthoptera larva closes up the mouth of the pitcher ere a sufficient supply of insects have been captured to properly nourish it, this Sarcophaga larva will nevertheless undergo its transformations, though it sometimes has not strength enough to bore its way out, and the diminutive fly escapes from the puparium, only to fiud itself a prisoner unless deliverance comes in the rupture or perforation of the pitcher by the moth larva or by other means. This rupturing of the pitcher does not unfrequently take place, for Dr. Mellichamp writes under date of June 27 as follows:—"Most old leaves now examined—I might almost say all—instead of being bored, seem ripped or torn, as if by violence, apparently from without. You see occasionally shreds of the leaves hanging. Surely the legless arva of Sarcophaga cannot do this! What then—toads, or frogs, or crawfish abounding in these moist, pine lands? or rather is not the fat maggot the occasion of the visits of the quail which lately I have observed here?"

[Here follow some technical facts and descriptions of interest only to specialists.]

These two insects are the only species of any size that can invade the death-dealing trap with impunity while the leaf is in full vigour, and the only other species which seem at home in the leaf are a minute pale mite belonging apparently to *Holothyrus*, in the Gamasidæ, and which may quite commonly be found crawling within the pitcher; and a small Lepidopterous leaf-miner, which I have not succeeded in rearing. There must, however, be a fifth species, which effectually braves the dangers of the bottom of the pit, for the pupa of Sarcophaga is sometimes crowded with a little chalcid parasite, the parent of which must have sought her victim while it was rioting there, as larva.

But all other insects, so far as we know, tumble into the tubn and there meet their death. The moth is doubtless assisted in walking within the tube by the spurs on the legs which it, iy common with most other moths, possesses; while the Flesh-fle manages to hold its own by its widely extended legs and stout bristles. Dr. Mellichamp says that when disturbed it buzzes violently about, just as if an animated sheep-bur had fallen into the tube—not apt to go down, because it will hitch and stick, and finally, by main force, it generally emerges, but once in a while also succumbs.

Two questions very naturally present themselves here:—(1) What gives the Flesh-fly more secure foothold on the slippery pubescence than the common house-fly exhibits? (2) What enables the larva of the Flesh-fly to withstand the solvent property of the fluid which destroys so many other insects? I can only offer, in answer, the following sugg stions: the last joint of the tarsus of the common house-fly has two movable, sharp-pointed claws and a pair of pads or "pulvilli." These pads were formerly supposed to operate as suckers, and all sorts of sensational accounts of this wonderful sucker have been given by popular writers, who forgot that there are any number of minute insects having no such tarsal apparatus, which are equally indifferent to the laws of gravitation so far as walking on smooth, upright surfaces, or on the ceiling, is concerned. In reality, these pads are thickly beset on the lower surface with short hairs, most of which terminate in a minute expansion kept continually moist by an exuding fluid—a sort of perspiration. Take the human hand, moistened by perspiration or other means, and draw it, with slight pressure, first over a piece of glass or other highly polished surface, and then over something that has a rougher surface, such as a planed board, a papered wall, or a velvety fabric, and you will experience much greater adhesion to the smoother objects, and may understand the important part which these moist pads play in the locomotion of the fly; they also act, in part, like the cushions of a cat's paw in protecting and preventing abrasion of the claws, which are very useful on the rougher surfaces, where the pads are less serviceable.

Now, compared with *Musca domestica*, the claws of *Sarcophaga sarraceniæ* are much the longest and strongest, and the pads much the largest, presenting three or four times the surface. These differences are, I think, sufficient to explain the fact that while the common fly walks with slippery and unsteady gait on the smooth pubescence (the retrorse nature of this pubescence sufficiently explaining the downward tendency of the movements), its sarcophagus congener manages to get a more secure footing;

for not only does the latter present a larger adhesive surface, but the longer claws are more likely to reach beyond the pubescence and the bristles, and fasten to the cellular tissue of the leaf beyond.

In answer to the second question, I can only say that there is nothing exceptional in the power of the larva to withstand the solvent quality of the fluid; it is, on the contrary, in accordance with the facts known of many species of Muscidæ and Estridæ, some of which, like the well-known horse-bot, revel in a bath of chyme, while others are at ease in the intestinal heat of other warm-blooded animals. It is also well known that they will often live for hours in strong liquids, such as alcohol and turpentine.

Conclusion.—To one accustomed to seek the why and wherefore of things, the inquiry very naturally arises as to whether Xanthoptera and Sarcophaga play any necessary or important rôle in the economy of Sarracenia. Speaking of the Sarcophaga larvæ, Mr. Ravenel asks, "May he not do some service to Sarracenia as Pronuba does to Yucca?" And if so, may not all this structure for the destruction of insects be primarily for his benefit? Can he be merely an intruder, sharing the store of provision which the plant, by ingenious contrivance, has secured for itself, or is he a welcome inmate and profitable tenant? Self-fertilisation does not take place in Sarracenia, and the possibility that the bristly Flesh-fly aids in the important act of pollination lends interest to the facts. No one has witnessed with greater pleasure than myself the impulse which Darwin has of late years given to such inquiries; but we should be cautious lest the speculative spirit impair our judgments or our ability to read the simple lesson of the facts. My own conclusions summed up are:—

1. There is no reason to doubt, but every reason to believe, since the observations of Dr. Mellichamp, that Sarracenia is a truly insectivorous plant, and that by its secretions and structure it is eminently fitted to capture its prey.

2. That those insects most easily digested (if I may use the term) and most useful to the plant are principally ants and small flies, which are lured to their graves by the honeyed path, and that most of the larger insects, which are not attracted by sweets, get in by accident and fall victims to the peculiar mechanical structure of the pitcher.

3. That the only benefit to the plant is from the liquid manure resulting from the putrescent captured insects.

[Mr. Ravenel, in making a transverse section near the base of the young leaf, noticed large tubular cells passing down through the petiole into the root, and much of the liquid manure may possibly pass through these into the root stalk.]

4. That Sarcophaga is a mere intruder, the larva sponging on and sharing the food obtained by the plant, and the fly attracted thither by the strong odour, as it is to all putrescent animal matter or to other plants, like *Stapelia variegata*, which give forth a similar odour. There is nothing to prove that it has anything to do with pollination, and the only insect that Dr. Mellichamp has observed about the flowers with any frequency, is a Cetoniid beetle, the *Euryomia melancholica*.

5. That Xanthoptera has no other connection with the plant than that of a destroyer, though its greatest injury is done after the leaf has performed its most important functions. Almost every plant has its peculiar insect enemy, and Sarracenia, with all its dangers to insect-life generally, is no exception to the rule.

6. That neither the moth nor the fly have any structure peculiar to them, that enables them to brave the dangers of the plant, beyond what many other allied species possess.

ON EVOLUTION AND ZOOLOGICAL FORMULATION*

IN the means which he has at his disposal for expressing the relative values of the facts of his science the chemist has an advantage over the zoologist which cannot be over-estimated. By a chemical rational formula it is possible to express, in a very small compass, facts of composition and decomposition, as well as many of the other relations borne by the constituents of a compound body one to the other.

In zoology formulation has received but little application; it has been employed to represent dental series and one or two other numerical points only; the cumbrous method of detailed verbal description being still resorted to in all cases, even when continuous observation has so accumulated facts, that it is almost impossible to retain the grasp of them without some auxiliary appliances. A method of zoological formulation, which, whilst expressing the facts of anatomical structure, attracts the attention to the relative importance of the observed differences, rather than to the details of the differences themselves, is a great desideratum; and it will be my endeavour on the present occasion to show how such a method can be made to assist in solving a problem so involved as the true affinities of a group of animals whose variable characters are fairly understood.

But the chemist has the atomic theory as a basis whereon to build; is there any principle in biology so inclusive as to yield a foundation on which to construct the desired system? Until the introduction of the theory of evolution and the doctrine of natural selection there was not. As long as the negative hypothesis of "special creation" held sway, the interest attached to the study of the mutual relations of organised beings was *nil*. No such relation could, in fact, have existed. But now, through the insight into nature arrived at by the all-embracing theories of Lamarck and Darwin—the Daltons of biology—the pedigree of the animal and vegetable kingdoms will form a problem which it will require many generations of the ablest zoologists to solve, even approximately, by the careful correlation of the undigested, unrecorded, and unobserved facts at their disposal.

Let us stop for a moment to glance at this doctrine of descent, in which, through the struggle for existence, by a process of natural selection, the fittest (for want of a better term) are said to survive. We may compare the living body of one of the higher animals to a cannon counterpoised on a Palliser gun-carriage, so fixed that it will hit a target situated at 1,000 yards distance. Before firing let marks be so made that the different parts of the whole engine can be afterwards adjusted to their former position. The gun is fired; the target is struck; a well-defined perforation or indentation is the result. A second similar shot is arranged for, by re-adjusting the engine with the assistance of the marks previously made; but on this occasion no direct aim is taken. The gun is again fired; but this time the target is missed, or it is hit in a different part. Why is this? It is because, in the former of the two firings, by the strain it caused to the whole machine, by the wear it produced in the rifling of the gun, and by the slight differences in the quality and quantity of the powder, the shot left the muzzle under different circumstances on the two occasions. The amount of this difference was sufficient, at the long range selected for illustration, to make the alteration in the course taken by the projectile perceptible. An external influence, the wind, is almost certain to have affected the result. This example shows how that minute differences, firstly in internal, and secondly in external circumstances, are sure to prevent the exact accordance of consecutive phenomena which might reasonably have been expected to be fac-similes one of the other.

As a general inference from every-day observation we are similarly led to expect that the offspring of living organisms will resemble their parent forms. But, as with the cannon, there are minor forces which in living beings come into play to produce slight changes in the progeny on all occasions. These changes are likewise of two kinds, depending on the circumstances connected with the parents themselves, and on those acting directly on the offspring from the time of its conception onwards. Amongst the former of these may be included differences in the actual and relative ages of the parents, both of which factors vary with each one of their progeny; their

* The substance of a lecture, introductory to the evening class of Zoology, at King's College, Strand. By Prof. A. H. Garrod, Fellow of St. John's College, Cambridge.

states of health, and their occupations. Amongst the latter are the habits and climate to which the offspring is subject. Causes of this nature, many of which are very incompletely understood, produce variations in the individuals of a species; and as the offspring resembles its parents, unless extra forces come into play to produce differences, the peculiarities of each variety are capable of transmission to the progeny. Thus, in course of time, strongly marked varieties of a species are likely to be developed; these give rise to others, until the descendants are very different from their ancestral forms. Time, however, besides continuing on the primitive stock and developing new varieties, produces other effects with equal certainty. Animals are dependent for their existence on a certain supply of organised food. Those living forms which furnish it have also been affected in a manner similar to their destroyers; like them, they have varied, and they have tended to become more numerous (the progeny in all cases being more numerous than the parents). The area of occupation being necessarily limited, and, as we are justified in assuming, fully stocked to commence with, the multiplication of the progeny develops a universal struggle for existence, one in which each individual, for self-preservation sake, participates; and in which the weakest goes to the wall. As in other contests, however, so in this, the race is not always to the swift, nor the battle to the strong, for many of the destroying causes are not those which are overt in their attacks. The sickly blade of grass, under the shelter of an overshadowing stone, protected from the browsing herd, fructifies and reproduces itself, whilst its free-growing neighbours form a delicious mouthful for the nibbling sheep. What amount of strength or courage can protect the leader of a flock from the ravages of an intestinal parasite? or prevent the largest individual of a flight of birds from being the most likely, on account of its greater superficial area, to be killed by a random gun-shot? Specialisation of function to resist special attack or to acquire special advantage, is, therefore, on account of the struggle for existence in conjunction with the tendency to vary, a factor of vitality. Specialisation in many directions is elaboration and progress so called; and as man possesses this in the most marked degree, he is considered to be the furthest removed from the living monad which gave him origin.

The pedigree of vitality is evidently, therefore, the greatest problem of biology; for a full comprehension of it includes all the minor details of the science. How is this to be arrived at? From any collection of people which comprises nearly all the living representatives of a family, it is not difficult to obtain a large amount of information with regard to the ancestry of that family by oral interrogation. This will be facilitated by classing together in groups those of equal kinship, placing in the same sections brothers and sisters, in larger divisions those who are first cousins, and so on. It will not be hard to find who were the grandparents of each, some probably being present; the great-grandparents of most will have only been personally known to the older; and more distant relations of the same line, by hearsay alone. Pursuing the investigation, the linking of each retrograde step will be found more difficult, and the difficulty of identifying the ancestor common to them all will be almost insurpassable. When an old family has very few living representatives or none at all, the facilities for studying it will be proportionately diminished.

In zoology the method of investigation for the purpose of classification is very similar. Instead of direct interrogation, answers are arrived at by an appeal to facts of existing structure. Similarity in habits, distribution, and external characters separate off closely related forms from their more distant allies. To solve the more difficult problems of less intimate relationships, recourse must be had to internal characters in addition; to points of difference in osteological and soft-part anatomy, many of which can only be arrived at by prolonged dissection and the employment of every available opportunity.

The difficulty of appreciating the relative value of differences in any group of animals that is forming the subject of investigation, that of separating the realisation of the characters themselves, independently from the words necessary to express them, has led me in the course of my dissections to adopt a method of formulating my results in a manner which at once places them in a form available for ready comparison, and in an order of relative significance; in fact as rational formulæ, which differ in arrangement according to the phases of my general ideas. An example of the application and the applicability of this method may not be without interest, and this I will draw from the sub-order Psittaci, the Parrots.

The parrots form a well-marked, easily distinguishable group, with no outlying doubtful genera; and as with many other well-marked groups, such as the Rodents amongst mammals, and the Umbelliferæ amongst phanerogamic plants, the minor divisions are not so easily determinable. In fact, there is a very great uniformity in all the external and internal characters throughout the sub-order. There are, however, a few points in which they present variations, those best known being (1) in the vessels of the neck, (2) in the ambiens muscle, (3) in the furcula, and (4) in the oil-gland. I will notice each of these points shortly.

Firstly, with regard to the vessels of the neck. In most of the higher animals an artery, the carotid, runs up each side of the neck to supply blood from the heart to the head. In birds these vessels generally run in the middle line of the front of the neck, side by side and in contact. In some parrots, and in them only, whilst the right carotid pursues its usual course, the left, leaving its fellows, runs separately at the side along with the left pneumogastric nerve. In several groups of birds the right carotid is absent, the left alone remaining in its normal position. This is the case with one genus of parrots. Secondly, the little long and slender muscle, the ambiens, whose tendon in its unique course obliquely traverses the front of the knee capsule, is absent in some parrots, being present in others. Thirdly, the furcula or merrythought, which unites the two shoulders by an osseous bow, may be present or absent. Fourthly, the oil-gland, situated just over the tail, is wanting in some genera.

Omitting for the time being the case, which amongst the parrots is found only in the genus Cacatua proper, in which the left carotid alone is present, there are sixteen possible combinations of the four characters under consideration, of which six are found to exist. They are the following:—

1. The carotids are normal; the ambiens is absent; the furcula is present, as is also the oil-gland.—(PALÆORNITHINÆ.)
2. The carotids are normal; the ambiens is absent, as is the furcula, and the oil-gland is present.—(STRINGOPINÆ.)
3. The carotids run abnormally; the ambiens is present, as is the furcula and the oil-gland.—(ARINÆ.)
4. The carotids run abnormally; the ambiens is absent; the furcula and the oil-gland are present.—(PYHRRURINÆ.)
5. The carotids run abnormally; the ambiens is absent, as is the furcula; the oil-gland is present.—(PLATYCERCINÆ.)
6. The carotids run abnormally; the ambiens is absent; the furcula is present; the oil-gland is absent.—(CHRYSOTINÆ.)

The facility for comparison afforded by a formulation of these results will be evident from an inspection of the following Table, in which the presence or absence of structures is represented by the signs + or —; in which the normal condition of the carotid arteries is indicated

by a Roman 2, whilst its abnormal state is indicated by the same figure in italics. The relative positions of the four different anatomical facts is retained throughout :—

TABLE I.

	Carotids.	Ambiens.	Furcula.	Oil-gland.
(1) PALÆORNITHINÆ .	2	−	+	+
(2) STRINGOPINÆ . .	2	−	−	+
(3) ARINÆ	*2*	+	+	+
(4) PYRRHURINÆ . .	*2*	−	+	+
(5) PLATYCERINÆ . .	*2*	−	−	+
(6) CHRYSOTINÆ . .	*2*	−	+	−

On this arrangement, the Lories, belonging to the *Palæornithinæ*, their zoological formula is 2 − + + ; whilst that of *Cyanorhamphus*, which is one of the *Platycercinæ*, is *2* − − +. By this means the relations of the different groups to one another are readily recognisable.

Next, in the attempt to arrive at a correct detailed classification, the question as to the zoological formula of the ancestral Psittacine form must be one of primary importance. This can only be arrived at by a comparison of the other bird-types with that of the parrots. Taking the characters employed in Table I., and similarly formulating such birds as the fowl, duck, rail, stork, and cuckoo, they all agree in being represented by 2 + + + (1) ; others, like the kingfishers and hornbills, have the formula 2 − + + (2) ; whilst a third type, with only a left carotid, are included in the L − + + type (3). No others of importance exist. From which of them did that of the Psittaci spring? It must have been from one; and, peculiarly enough, there are genera to be found among them which closely approach all three, for—

The formula of *Pittacus* is *2* + + +
" " *Palæornis* " 2 − + +
" " *Cacatua* " L − + +

However, this only shows that the sub-order is a very ancient one, and has undergone changes analogous to the whole class *Aves*, and it does not complicate the problem in the least.

There are parrots with two normal carotids, *e.g.* the *Palæornithinæ* ; there are others in which the ambiens is present, *e.g.* the *Arinæ ;* most have a furcula and also an oil-gland.

Now suppose that when steam-engines were first introduced they had all been constructed with steam-whistles attached. Suppose that shortly afterwards several had been exported to different colonies, and that ever afterwards each colony had, with the originals as patterns, gone on constructing them for their own use, improving upon the original design as they thought best. Suppose that by certain individual manufacturers a gong was substituted for the whistle ; in others a bell, and in a third no sounding apparatus at all. A traveller going through the different countries at the present time would probably find whistle-engines wherever he went, though in different places gongs or bells will have replaced the whistle. Knowing nothing about the history of the steam-engine, is he not justified in inferring that it was originally constructed with a whistle ; for otherwise would it be likely that each colony should have independently employed the same method of signalling, when there were several to be chosen from ?

The naturalist, similarly, as an uninitiated looker-on at the contrivances of nature, finds the same type of structure running through forms not very intimately allied ; as, for example, two symmetrical carotids, in reptiles, mammals, and some birds ; or an ambiens muscle in the fowl, the eagle, the cuckoo, and the plantain-cutter. When, therefore, these fundamental arrangements are found to exist (though perhaps not combined in any one individual) in any well-defined group like the parrots, may it not be legitimately inferred that the ancestor of that group possessed them in their full and unmodified form ? Undoubtedly it may ; and on this principle we can almost certainly assume that the ancestral parrot possessed two normal carotids, an ambiens muscle, a complete furcula, and an oil-gland ; in fact, that its formula was 2 + + + ; and that all those species in which one or other of the included characters differ from this *type formula*, they do so on account of forces having modified the ancestral form. This line of argument therefore leads us to infer the extinction of the earliest form of parrot, unless some yet undissected genus is subsequently found to correspond with it ; and all the existing genera must be referred to collateral branches, in which at least one operation of modification has been accomplished. Those which have undergone no further change from the 2 + + + type are the *Palæornithinæ* (2 − + +), and the *Arinæ* (*2* + + +). Now the question presents itself, are all those with the modified carotid (*2*), members of a single stem, and those with the unmodified carotid (2) members of another, similar losses having occurred in both to develop the subjoined series ?

TABLE II.

2 − + +	*2* + + +
2 − − +	*2* − + +
L − + −	*2* − − +
	2 − + −

Or must those types be blended in which the formulæ correspond, irrespective of the carotids ? My placing the carotid index first expresses my belief as to its primary importance ; and this is because the conformation it represents is extremely peculiar and unique among birds, and is therefore less likely to have appeared except as the operation of a specially applied force on a single collection of individuals, the power of transmission being inherited. From this it may be inferred that the ancestral unmodified stem shortly sent off a branch represented by *2* + + +, which persists as such in the *Arinæ*. The main stem and its branch must each have, before long, had a branch of its own, represented by 2 − + + and *2* − + +, which persist as the *Palæornithinæ* and the *Pyrrhurinæ*. From the 2 − + + division sprang the 2 − − + (*Stringopinæ*), and the genus *Cacatua* (L − + −), as did the *2* − − + (*Platycercinæ*) and the *2* − + − (*Chrysotinæ*) from the *2* − + + division. The genus Cacatua is peculiar in having only the left carotid running normally, it must therefore be connected with the normal 2 carotid stem, and many Cacatinnæ, like the Cockateel and the Banksian Cockatoo, are represented by the formula 2 − + +. Some of the true Cockatoos, and some only, have no oil-gland.

My object in giving this somewhat lengthy illustration on the present occasion is to show how much facility a method of formulation affords in the working out of a minor problem of the great doctrine of heredity, such as the classification of the parrots. It makes comparison easy, it facilitates the performance of operations of addition and subtraction, bringing all the stages of the process before the mind's eye without any mental effort. Is it not one to be further developed ?

THE OPTICS OF THE SPECTROSCOPE

NOW that the Spectroscope is becoming an instrument of world-wide use, we think it will be not uninteresting to call attention to some few points that appear to be often overlooked in designing the instrument for various purposes ; and in order to ascertain the best arrangement, we cannot do better than analyse the effects produced in any spectroscope by varying the proportion of its parts. We must, however, premise by saying that the power of an instrument is not altogether dependent on the dispersive power of the prisms, but also on the width of the image of the slit in the eyepiece of the tele-

scope of the spectroscope. To make our meaning clear, let us suppose that the slit is illuminated with a sodium flame, then the dispersive power of the prisms will produce in front of the eyepiece two images, or "lines," and with the same lenses the distance of their centres will depend upon the prismatic power; but it is clear that if the slit be widened, the two images will eventually widen until they touch each other or overlap. There is, then, the same dispersion, but less separation, than when we use the narrow slit; and it would follow from this that with an almost indefinitely small slit a prism of very small dispersion would give two separate images of a sodium-illuminated slit, which could be magnified so as to have their distance and width the same as would be given by using a wider slit and greater prismatic dispersion; but with an eyepiece of the large power required, the lines would be so diminished in brightness as to preclude this arrangement; and in order to see a spectrum as brilliant as possible, the eyepiece ought to be as low in power as possible consistent with reducing the cylinder of rays sufficiently small that they all enter the lens of the eye.

Let us now consider a spectroscope of any number of prisms having the focal length of the collimator the same as that of the telescope: then the image of the slit in the focus of the telescope will be of the same size and of the same brightness; for we must, for this consideration, omit the loss of light by reflection and absorption for the present, as the slit itself, which we will first suppose illuminated by sodium light, so that two yellow images of it will be visible in the eyepiece. Afterwards we will consider the case in which sun-light is used. First let us consider the effect of opening the slit wider, say double the width. By this means the images will be doubled in width and the separation diminished; the amount of light will be doubled, but will be spread over double the area, so the intensity of illumination will remain the same; therefore the slit should be as narrow as possible consistent with the image being wide enough to be visible. Secondly, let us double the length of the collimator. By this we halve the width of the image of the slit, so that the separation is increased, but the distance between the centres of the lines remains the same; the angle subtended by the collimating lens will in this case be halved, so that the amount of light passing will only be $\frac{1}{4}$ of the original amount, but as the image of the slit is reduced in like proportion, the intensity of illumination remains the same; the effect in this case is therefore the same as narrowing the slit, with the exception of the lines being shorter, thereby reducing the width of the spectrum—a matter generally of little moment, which can be altered at ease by lengthening the slit. Thirdly, we will double the diameter of the collimating lens, and with it that of the telescope and the prism. By these alterations the amount of light passing becomes quadrupled, therefore the images of the slit will be four times brighter; but the angle subtended by the telescope lens at the image is doubled, so that in order to get the whole of the light into the eye, the eyepiece must be placed at half its distance from the image, and be consequently doubled in power; the images will by this be reduced to their original brightness, but they will be magnified at the same time, and the distance from centre to centre doubled, the separation doubled, and the width of the images doubled, so that the slit may be reduced in width by $\frac{1}{2}$, and yet leave each image as wide as at first. This will increase the separation between the interior sides of the image still more, so that by doubling the size of our lenses and prisms we have obtained double separation of centres of images, and more than double separation between images, which is just what would be produced by doubling the number or dispersive power of the prisms. It is therefore obvious that in dealing with a bright-line spectrum the power of the instrument depends on the size of the prisms as much as on their number, and an increase in number means an increase in the number of reflecting surfaces and loss of light, so that within practical limits an increase of size is the more preferable. Practically, on increasing the size of the collimating lens, as in this case the focal length should be increased, otherwise the lens is injured in defining power, the effect of this increase is, as shown in the second case, only equivalent to closing the slit, so it is better to lengthen the collimator instead of touching the slit; it is also better to increase the focal length of the telescope glass, thereby straining it less, and so increasing the size of the image of the slit without altering the power of the eyepiece.

Now let us consider the effect of these alterations on sun-light or other light giving a dark-line spectrum; and there is this difference between the consideration of this spectrum and the bright-line spectrum, for in this case the dark lines are not images of the slit, but intervals between them, and therefore their width and appearance depend not so much on the separation between the centres of the bright lines as on the separation of their adjacent sides, and with the same width of any two bright lines this separation or width of dark line does not vary in the same ratio as the distance between the centres of the bright lines, or as what is called the dispersive power, varies, but in a higher ratio. For example: suppose there appear in a spectroscope the two sodium lines of appreciable width with the finest possible dark line between them; then, if the distance of their centres is doubled without increasing their width, the black line becomes increased by the increment of the distance of their centres, and with this increment the original dark line becomes much more than doubled; this will be seen better by drawing two bright lines of appreciable width on paper, and going through the process just mentioned. It is therefore separation, according to our definition of the word, that is required for dark-line spectra.

We will now consider the effect when using sun-light instead of sodium light in a similar manner to our first arrangement, namely, in our normal spectroscope, and let us widen the slit as we did before. Every image of the slit will then widen, and the separation between the sides of any two images will diminish, and therefore the dark lines will diminish in width as they are encroached on by the light on either side; the general spectrum will, however, increase in brilliancy, for although each image is only increased in size, as was the case with sodium light, still the images of each colour overlap, and so produce greater intensity. From this we gather that to obtain the greatest number and width of dark lines, the width should be as narrow as is compatible with sufficient illumination of the spectrum, to show up the dark lines; and so with a dark-line spectrum as with a bright-line one, the slit should be as narrow as possible.

Secondly, as with the sodium light, let us lengthen the collimator, say double it: then, as with the sodium light, the images will be halved and the separation increased, but only $\frac{1}{4}$ of the light passes, and the spectrum is reduced in width by $\frac{1}{2}$, so that its brilliancy is $\frac{1}{2}$ what it was originally; or we may account for the decrease in brilliancy by considering that although, as we showed in the case of the sodium light, the images of the slit are not reduced in brilliancy, still there is less overlapping and so less brilliancy. So we see that in order to keep a sufficient brightness of spectrum to show the dark lines, we must open our slit if we lengthen our collimator, and *vice versâ*, so that no power is gained by either of these methods, as was the case with the sodium light. Thirdly, we will double the diameter of the collimating lens, and with it that of the prisms and telescope object-glass. By this means the brilliancy only of the spectrum is changed, and this is quadrupled in the focus of the eyepiece, but the focal length must be halved in order to reduce the cylinder of rays small enough to totally enter the eye: this will magnify the spectrum to double its original size in every direc-

tion, and so double the width of the dark lines, but will produce no new ones; it will also reduce the brightness of the spectrum to its original state. Now, when we were dealing with sodium light, we at this stage of proceeding halved the width of the slit, for the images of the slit had been doubled without their brightness being reduced, so we could halve them and bring them to their original size, and so increase the distance of separation still more; but with a continuous spectrum, if we close the slit we shall, it is true, only decrease the width of each image of the slit and not their brightness, but we decrease their overlapping and so decrease the brilliancy of the whole spectrum, and this we cannot afford to do, as we have started with as narrow a slit as possible, and consequently with as small a brilliancy as possible consistent with showing the dark lines. We have therefore by this alteration of size of glasses doubled the width of dark lines originally visible, but we are not able to more than double the separation of any two images of the slit, as we did with the sodium light images, by narrowing the slit in addition to increasing the distance of the centres, and therefore no new lines are produced; in fact, the result of our change of arrangement has been the same as a simple magnification of the spectrum without a decrease in brilliancy; and an increase of prismatic power is exactly similar in effect, as we shall presently show, though it seems at first untrue that increase of prismatic power will not increase the number of dark lines visible. Let us now double the number of prisms; then the length of the spectrum will be doubled, and the distance of the centre of the images of the slit doubled, and therefore more dark lines may appear in addition to the original ones being widened, but the brilliancy of the spectrum has been halved, and in order to brighten the spectrum to the original state the width of the slit must be doubled, which exactly undoes all that the extra prisms have done in producing more lines; for the images will expand and obliterate the newly-formed lines; the original dark lines will, however, after the widening of the slit, be double their original width; so that, as we have just stated, the increase of prismatic power will not make a greater number of dark lines visible. If we illuminate the slit more intensely, we may decrease the width of the slit and still retain our original brightness, and so obtain a reduction in the width of the images, and consequently a greater separation between their edges, and therefore an increase in the number of dark lines in addition to increase of width of those originally visible; so that for the same kind of light the number of dark lines depends on the intensity of the illumination of the slit.

In dealing with the spectrum of an intense light like that of the sun, where there are a large number of lines, it is necessary to use an instrument of high power, whether in number or size of prisms, in order that the exceedingly fine dark lines produced by a low power may be, as it were, magnified without loss of light, which is, as we have shown, the effect of an increase of prismatic power; and in order that these fine lines may become visible and sufficiently separated to render their identity for measurement or otherwise complete, so there may be an apparent increase in the number of lines by the invisible ones being rendered visible by magnification without loss of brilliancy in the spectrum.

But in dealing with light like that from a planet or the moon, where the slit must be so wide that few lines are visible, it can soon be tested in practice that the increase of power does not increase the number of lines. In examining the light of the moon or of a nebula, or any object having an appreciable diameter, any increase of telescopic power for the purpose of forming the image on the slit will not increase the useful brightness of the slit; for, supposing a spectroscope be working to its greatest advantage on a telescope, then, if the diameter of the object-glass of the telescope be doubled, the angle it subtends at the slit will be doubled, and the cone of rays on the collimator side of the slit will have its base doubled, and therefore it cannot all pass through the collimating lens; in fact, all the rays newly added by the increase of diameter of object-glass will be wasted against the tube of the collimator, and if we try to utilise these rays by increasing the size of collimating lens or decreasing its focal length, we shall also have to increase the power of the eyepiece to get all the rays into the eye, and so reduce the brilliancy of the spectrum to its original state. In the case of increasing the focal length of a telescope as well as its aperture, the brightness of the image on the slit is not increased, but only its size; so the spectroscope is unaffected. But in the case of viewing the spectrum of a star, matters are altered, for the image of the star does not increase in size by increasing the focal length of the telescope together with its apertures; but its brilliancy is increased, and therefore greater prismatic power can be used without increase of width of slit, and more dark lines seen; so that for stellar spectroscopy an increase of telescopic apertures is a direct advantage. From the foregoing remarks we gain that in the construction of a spectroscope the eyepiece should be of as long a focus as possible, so as just to cause all the rays to enter the eye; all magnification beyond this means loss of brilliancy, and if the spectrum appears insufficiently large an increase in size of the collimating and telescope lenses, together with the prisms, or an increase in the number of the prisms should be made, until the spectrum appears sufficiently large to suit the requirements of the observer. G. M. S.

THE SUB-WEALDEN EXPLORATION

THE Secretary of the Sub-Wealden Exploration has just issued his eighth quarterly report, in which he states that but little progress has been made during the last three months in consequence of the inability to procure lining tubes of the required size in sufficient quantity. The increased favour in which the diamond boring system is now held has caused a great demand for these tubes, and they are specially manufactured by an eminent Birmingham firm. The new pipes are required for the difficult process of enlarging and lining the bore-hole to the diameter considered requisite before attempting to withdraw the broken rods, &c. Mr. Willett says:—

"The engineers have no doubt whatever of their ultimate success, and as the extraction of the rods is not a matter involving the expenditure of our funds, we can only regret the loss of the long summer days, and take comfort from the assurance that, 'after the enlargement and lining is accomplished, there is a much better prospect of obtaining the desired depth of 2,000 ft. than there was a year ago that we should reach half the distance (1,000 ft.), provided always that the *requisite funds be forthcoming*.'"

He is anxious to dispel what he terms "the delusion" that no more money is required from the public in consequence of a Government grant to the work having been obtained. He states that the Chancellor of the Exchequer, with laudable foresight and prudence, has promised to assist on certain conditions, to do which—

"I. We must spend 400*l.* in boring tubes, &c.

II. We must bore 100 ft., which will cost 200*l.*; and *then*, and *not till then*,

III. We can draw 100*l.* from the Exchequer, and so on, claiming 100*l.* for every 100 ft. actually explored."

The third and last year of the tenancy for carrying out the work has been entered on, and therefore the necessity of speedily resuming the operations is at once seen. The financial position is cheering, the present balance being 594*l.* 7*s.* 9*d.* The honorary secretary says:—

"We are greatly indebted to the Right Hon. the Chan-

cellor of the Exchequer, and to the Secretary of the Treasury (by whom the deputation was introduced), for having favoured us with an interview and patiently listened to our appeal for Government aid.

"The grounds of our claim were stated in our last report, and were naturally met by the remark that 'it would be a dangerous precedent to apply national funds for private purposes.' If all future applicants be compelled to

I. Raise 3,000*l.* by subscription ;
II. Bore 1,000 feet ; and
III. Obtain a memorial from the Royal Society, the Geological Society, and the Institute of Civil Engineers, stating that the prosecution of the work is of national importance ;

they are not likely to be troublesome by their numbers, and the subject having been ventilated in the House of Commons, few reasonable minds will be disposed to doubt the discretionary wisdom of the grant with its attendant conditions.

"We are much indebted to William Topley, Esq., F.G.S., for having consented to visit Belfast, there to read our report and make personal application for additional aid from the Committee of Recommendation of the British Association for the Advancement of Science, and we are greatly encouraged by the response and the grant of 100*l.*

"The kind promise of Sir Charles Blunt to give us 50*l.* on reaching 1,000 ft. has been faithfully performed ; so also will Mr. Warner's promise of 300*l.* when we reach 2,000 ft.

"In scientific research it has often occurred that the benefits accruing have been indirect and unexpected by the promoters. Not only have the rich beds of gypsum been made known, and, in consequence, are now in actual process of development, but the new facts ascertained by our work have thrown some considerable light (and that of an encouraging nature) on the problem of the feasibility of constructing a sub-marine tunnel between England and France.

"The motives which actuate our friends to subscribe are various and sometimes novel, as, for instance, one writes : 'I enclose my mite—besides the objects stated, a shaft is doubtless a safety valve against earthquakes.'"

The report concludes by thanking the directors of the London, Brighton, and South Coast, and the South Eastern Railways, for their assistance in the work, the latter company having, in addition to granting other privileges, in the use of their line, forwarded a cheque for 50*l.* The kindness of the Earl of Ashburnham, the Rev. T. Partington, and many others is acknowledged, and the honorary secretary concludes his report with an earnest hope for further encouragement, and that the results will prove that their labour has not been expended in vain.

NOTES

THE inhabitants of a vast district of London have had during the past week an opportunity of studying the phenomena of explosions on a large scale, and of noticing how closely they approach those of earthquakes in the sequence of long-rolling waves of the solid earth, loud noises, and finally long continued tremulous motion and more subdued sounds. If we could have announced last week that 100 barrels of gunpowder would explode in London, locality not defined, on a given day, the inhabitants would probably have been alarmed, many would certainly have visited their country friends ; but our Government have for years been warned that such an occurrence might happen seeing that there is no legislative enactment to ensure care, and yet they have let such a state of things continue ! We have it on the authority of the *Times* that the *Tilbury* might have had 500 barrels on board instead of 100, and it is clear that these might have exploded in a locality where the consequent destruction of life and property would be fearful to contemplate. It appears that, bad as are the regulations for the transport of gunpowder on board ship, there is little or no provision for the prevention of accidents at places where powder is received and delivered in large quantities. In reporting on this branch of the subject in 1865, Major-General Boxer instanced the case of Isleworth. He says :—"The powder wharf at Isleworth affords a good illustration. This wharf is situated in the town of Isleworth, on the banks of the Thames ; on an average as much as 600 barrels per week is shipped there, the wharf is surrounded by houses, and the sacrifice of life would be fearful in the event of an explosion." Major Majendie, in a report to Government two years ago, wrote :—"I am quite sure that if the public were at all aware of the extent to which gunpowder is handled in large quantities, without any special regulations, in the middle of the metropolis and of large cities, they would be seriously alarmed, and would demand the adoption of measures for removing so patent a danger." Truly we are a practical people, and much superior to the Germans, who only allow the transit of large quantities of gunpowder through populous districts under military escort.

THE effect of the explosion in the Zoological Gardens was not so serious as might have been expected from the proximity of the gardens to the scene of the disaster, but several of the animals were thrown into a state of great agitation. The elands, antelopes, and deer, particularly, were very much startled, and were found running round their enclosures in a state of great alarm. The elephant, hippopotamus and rhinoceros, and the giraffes were very much excited, and the birds became much alarmed. About a dozen of the smaller birds escaped through a hole in the glass roofs of the aviary, caused by the concussion, but two or three returned during the day. The blankets and coverings were shaken off the snakes, but fortunately none of the glass in their cages was fractured. It was fortunate, too, that none of the large carnivora were liberated.

WE referred some little time ago to the fact that a sum of about 30,000*l.* had been left to the "London Academy of Sciences." We hear that already several societies and institutions have sent in, or are thinking of sending in, claims. It is stated, however, that the Royal Society, which certainly is the nearest approach to the institution in Signor Ponti's mind, has not applied. The Royal Society is of course a mere private body, and might well be held to be justified in refusing to incur the responsibility of distributing a large sum for the furtherance of science ; but the miserable chaos in our scientific arrangements is none the less strongly brought out by the present juncture. In England, truly, Science is a body without a head !

FRANCE, Germany, and Austria are vying with each other in astronomical activity. In the grounds of the Paris Observatory a 4-ft. Foucault mirror is being erected, and M. Le Verrier has already obtained a grant for a 30-in. refractor. The Vienna Observatory is also making arrangements for the reception of a telescope of similar aperture. Messrs. Merz have nearly completed a lens of 20 in. aperture, for the University of Strassburg. In France, the newly-created *Ecole Speciale des Hautes Etudes* is being taken advantage of to form a school of Astronomy ; in Germany and America many such schools exist already, thanks to the rational administration of their Observatories, the assistants in which are the pupils, friends, and potential successors of the director.

M. DESJARDINS, one of the head officials in the Ministry of Public Instruction, has been ordered by the Minister to inspect the meteorological service of the Observatory and to report upon its present condition.

THE Government of Newfoundland has determined to take steps for the protection of the seal fisheries, by preventing vessels

from leaving port before a certain date, and are anxious to induce the Governments of other countries, whose subjects are engaged in other fishings, to take similar measures in respect to vessels leaving their respective ports. It is hoped thereby to establish an international convention, which will have the effect of giving the seals at least another month after the breeding season, in which the young may increase in size and value, and thus the fearful slaughter of immature seals which has threatened the total extermination of the animal will be checked.

THE ordinary business of the Paris Academy of Science was entirely suspended at the meeting on September 28, owing to the death of M. Elie de Beaumont. The burial took place on the 25th, the entire Academy attending their *confrère* to the grave. Funeral addresses were delivered by M. Dumas on behalf of the Academy, by M. Ch. Sainte-Claire Deville on behalf of the Mineralogical Section, by M. Daubrée in the name of the School of Mines, and by M. Laboulaye in the name of the French College.

THE President and Council of the Royal Society of Edinburgh, "impressed with the conviction that the progress of the sciences demands, and has long demanded, fuller and more exact tables of logarithms than any which at present exist," have memorialised Sir Stafford Northcote with the view of inducing the Government to print a nine-figure table of logarithms of numbers from unity to a million, part of which has been already calculated by Mr. Sang, who has carried a fifteen-figure table up to 300,000. The subject of undertaking the publication of logarithm tables—so long as the number of figures does not exceed ten, the limit of utility—is one well worthy the attention of the Government; but in the present case there are several reasons why, if the application is refused, the loss to science will not be so great as some might think. In the first place, a table of 1,800 large pages, whether in one, two, or three volumes, will be so unwieldy that, notwithstanding the ease of the interpolations, it would probably be very seldom used by computers; and secondly, because all who require more than seven figures will, no doubt, prefer to use ten, and consult the existing works. In fact, nearly all computers would, we believe, employ Vlacq or Vega in preference to the proposed table. Mr. Sang, in the pamphlet which accompanies the memorial, makes a remarkable error when he intimates that the great French tables have not been used to verify any seven-figure table, so that "up to the present moment we have no verification of Vlacq's great work." In point of fact, the whole of Vlacq was read with the copy of the French tables at the Paris Observatory, by M. Lefort, and the results of the comparison are published in vol. iv. of the "Annales de l'observatoire de Paris." Almost all the errors found by Mr. Sang by means of this table are among those there given by Lefort, and anyone who chooses can, without much expenditure of trouble, render his copy of Vlacq all but free from error—much more accurate than any new table could possibly be.

ATTENTION is being again directed to the cultivation of Cinchonas in St. Helena, which at one time promised so well, but which has, owing to changes in the Government, been allowed to lapse into decay. Some seven or eight years since, when the island was under the governorship of Sir Charles Elliott, Dr. Hooker strongly advised a trial of the plants to be made, and plantations were formed at Diana's Peak. So satisfactory was the progress of the plants that the Government consented to the selection of a gardener from amongst the best or most intelligent of those to be obtained at Kew. One was chosen and sent out, and, to quote from a recent number of the *St. Helena Guardian*, "All went well so long as Sir Charles Elliott was at the head of affairs: plantations were formed, and the gardener, Mr. Chalmers, was treated as one having the charge and responsibility of an important colonial experiment, and the plants grew well up to the time when Sir Charles Elliott left and Admiral Patey was appointed in his stead. The new governor at once decreed that the plantations at Diana's Peak were a mere foolish waste of money, that the gardener sent out from Kew would be better employed at Plantation House, and employed he was, chopping firewood and raising beans, peas, and radishes, and selling them for the benefit of the privy purse of Government House, and the Cinchona plantations were left to go to ruin or to flourish by their own unaided vigour, as the case might be." The result of three years' cultivation and three years' subsequent neglect seems to be, that although there are a few dead and sickly plants, nearly all the trees are in full vigour and luxuriant growth. There are about 300 flourishing plants, many of which are twelve feet high, and three to four feet in diameter. The bark is also a quarter of an inch thick, and has an intensely bitter quinine taste. Many of the plants in the St. Helena plantations have the lower part of their stems bound up with moss in order to try if the bark would not swell and increase more rapidly, but it has had the effect of showing, by the bursting out of rootlets from the part so bound with damp moss, that the plant throws forth roots readily from the bark, and thus may be easily propagated by cuttings. The Government has recently been again in correspondence with Dr. Hooker on this subject, and it is to be hoped that the cultivation will be again renewed and prosecuted continuously.

WE have been requested to publish the following extract of a letter recently received from Cambridge (Mass.):—"We have been very much amused by the pertinacity with which our friends on your side are determined to provide us with a successor to Prof. Agassiz, to fill a vacancy which has no existence and has been filled long since. Alex. Agassiz takes his father's place in the Museum, assisted by Count Pourtales and Col. Lyman, who attend more to the details; and the professorship has been divided, and separate professors appointed, one for zoology and one for geology. There is now therefore no vacant chair in Harvard, so far as I know, although Prof. Wyman is lately deceased; but I think he relinquished his duties some time since, on account of ill health. So I do not perceive the slightest chance for the numerous successors proposed in England or elsewhere."

THE French Geographical Society sent a deputation to Vienna to offer its official congratulations to the Hungro-Austrian Polar Expedition. It was very cordially reciprocated by Payer and his associates.

AN International Horticultural Exhibition will take place at Antwerp, commencing on April 4, 1875, under the auspices of the Royal Society of Horticulture and Agriculture of that town, and promises to be on a large scale. An International Exhibition of Fruits will also be held at Amsterdam in October 1875, under the management of an influential committee.

WE learn from the *Belgique Horticole* that that cryptogamic pest the *Puccinia malvacearum* is making sad havoc among the mallows and hollyhocks in some parts of Belgium.

WE are informed that the *Phylloxera* has appeared in Switzerland, and that the delegates of the wine-growing cantons met on Monday last, the 5th inst., to consider the best means of preventing its extension.

SOME excitement has been aroused in New York by the discovery of a rich vein of hæmatite iron ore in the heart of the city by some workmen who were digging foundations for a new building. The vein, which is 30 ft. wide, was found at a depth of only 4 ft. from the surface.

PROF. BENTLEY and Mr. Trimen are engaged in the production of a voluminous work on the medicinal plants of the world.

As there are not many works devoted to this important branch of botanical science, we shall gladly welcome this book, as from the well-known abilities of the authors we have every reason to anticipate that it will at once take a prominent position among standard works on this subject. It will be copiously illustrated.

Dr. Humphrey, F.R.S., the Professor of Anatomy at the University of Cambridge, gives notice that his course of lectures on Practical Anatomy will begin on Thursday, Oct. 8, at 9 A.M., and be continued daily. The course on Anatomy and Physiology will commence on Friday, Oct. 23, at 1 P.M., and be continued on Tuesdays, Thursdays, and Saturdays, at the same hour. This course is intended for students of natural science as well as for students of medicine, and gentlemen not requiring certificates are at liberty to attend without fee.

A telegram received at Hull from the captain of the schooner *Samson*, which has just returned from a cruise in the Arctic regions, announces the discovery of large beds of coal at Spitzbergen.

The volcanic soil in the neighbourhood of Vesuvius is stated to be an antidote to the potato disease and other fungoid diseases of plants. It is also said that it is found of great value in the treatment of *Phylloxera*; this, however, remains to be proved.

The inaugural meeting of teachers, students, and friends of the College for Men and Women (with which is incorporated the Working Women's College) will be held at St. George's Hall, Langham Place, on Monday, October 12. The chair will be taken by Mr. Thomas Hughes, Q.C., at 8 P.M. The College is established to afford to men and women occupied during the day a higher education than has generally been within their reach. The classes are taught for the most part gratuitously, and the design is that mutual help and fellowship may be promoted between all members of the College, teachers and students, by the educational work in the classes and the social life of the coffee-room.

The Statistical Society, that has occupied apartments at No. 12, St. James's Square, for nearly thirty years, as a tenant of the London Library, has recently changed its quarters to the house formerly occupied by the Principal of King's College, and its present address is Somerset House Terrace, Strand, W.C., London (King's College entrance). This change has become necessary by the simultaneous growth and development of both the London Library and the Statistical Society, and is therefore a matter of congratulation to both institutions.

We have to record the death, on Saturday last, of Dr. William W. Fisher, Downing Professor of Medicine in the University of Cambridge since 1841, when he succeeded Dr. Cornwallis Hewett. Dr. Fisher, from being an undergraduate, first at Trinity and then at Downing College, became Fellow of the latter, and remained so until he accepted his Professorship. He was formerly physician to Addenbrooke's Hospital, and till his death steward and librarian of his College. The stipend of the Professorship is 400*l.* a year with a residence in Downing College; it must be refilled within two months of a vacancy occurring.

The opening meeting of the approaching session of the Medical Microscopical Society will take place at the Royal Westminster Ophthalmic Hospital on Friday, the 16th inst., at 8 P.M.

Alphonse de Candolle, of Geneva, whose first botanical memoir was published forty-five years ago, has been elected one of the eight foreign associates of the Academy of Sciences at Paris, in the place of Agassiz.

M. Melsens, a member of the Royal Academy of Belgium, has published a pamphlet describing the verification of lightning-conductors, as practised by him in several monuments of Brussels, for ascertaining if they are in a position to conduct electricity into the humid parts of the earth. The experiments were tried with a Hely machine, and with Daniel elements and galvanometers. In the first instance fifteen of the pupils of the Veterinary School were employed to ascertain if they had received any shock.

The reptiles of the French Museum have been removed to their new home. The boas had been previously overfed, so that they were as easy to handle by the keepers as so many cables. The crocodiles were most unmanageable, and it was necessary to use nets in order to catch them. Some of the venomous snakes were tempted by food offered to them into small cages, in which they were shut up hurriedly, and removed. Now everything is right, and the several inhabitants of the reptile menagerie are happy and contented in the new building which will be formally opened within a few days by the Minister of Public Instruction.

The death is announced of one of the most prominent and indefatigable members of Col. Gordon's expedition, Mr. Anson, who succumbed to an attack of fever on the 27th of July. The deceased was the son of Admiral Anson, and was highly esteemed by Col. Gordon for his zeal and usefulness.

M. X. Ducloux has discovered and given the name of *Rivotita*, or Rivotite (in honour of the memory of M. Rivot, late Professor of the School of Mines, at Paris), to a new kind of mineral, which is found in small irregular masses, dispersed in a yellowish-white chalk, upon the western slope of the Sierra del Cadi, in the Spanish province of Lerida.

We have received the Sixth Annual Report of the Cardiff Naturalists' Society, and are pleased to notice that the year just closed has proved most successful; the number of members has increased from 190 to 288, and the finances of the society are in a good condition. During the past year, the committee have organised for the first time a series of scientific and literary lectures, which have been largely successful.

The additions to the Zoological Society's Gardens during the past week include two Call Ducks (*Anas boschas*), European, presented by Mrs. Wilson; four Little Bustards (*Tetrax campestris*), European, purchased; a Rhesus Monkey (*Macacus erythræus*) from India; a Solitary Tinamon (*Tinamus solitarius*) from South America; three Lesser Pin-tailed Sand Grouse (*Pterocles exustus*) from North Africa; two Cornish Choughs (*Fregilus graculus*), European, deposited.

SCIENTIFIC SERIALS

The *Journal of the Chemical Society* for August contains, in addition to the usual abstracts from foreign journals, the following papers communicated to the Society:—On ipomœic acid, by E. Neison and James Bayne. This acid, obtained by the action of nitric acid upon jalapin, has been shown by the authors to be identical with sebacic acid. This conclusion has been arrived at from a comparison of the solubility, melting-point, and composition of the acids. The potassium, barium (normal and acid), lead, and silver salts have been prepared and examined.—Note on New Zealand kauri gum, by M.M. Pattison Muir. The gum is an exudation from a coniferous tree (*Dammara Australis*) imported into this country for the purpose of making varnish. The action of different solvents and of various reagents has been tried, from which it appears that the substance is a mixture of resins with a true gum, and is therefore to be classed as a gum-resin.—On certain compounds of albumin with the acids, by George Stillingfleet Johnson. Compounds with nitric, hydrochloric, sulphuric, orthophosphoric, metaphosphoric, citric, oxalic, tartaric, and acetic acids have been obtained. The method of preparation consists in dialysing white of egg over dilute solutions of the acids. The action of water heated above its boiling point upon these compounds has been studied, and special experiments undertaken to ascertain the nature of the

action exerted by the dialyser in producing the compounds. The author concludes that the following points have been probably established by his experiments:—(1) The existence of definite compounds of albumin with the acids in simple molecular ratios (the probable formula of the nitric acid compound may be given by way of illustration—$C_{72}H_{112}N_{18}SO_{22}2HNO_3$). (2) The applicability of dialysis to the ready and accurate preparation of these compounds. (3) Probable correctness of the formula of Lieberkühn, Loew, and Liebig for albumin.—On a simple method of estimating urea in urine, by Dr. W. J. Russell and S. H. West. The authors make use of the well-known action of hypochlorites and hypobromites upon urea:—

$$CO(NH_2)_2 + 3HClO = CO_2 + 3HCl + 2H_2O + N_2.$$

The most advantageous solution for this purpose is formed by dissolving 100 grms. of caustic soda in 250 c.c. of water, and adding 25 c.c. of bromine. A measured quantity of urine is introduced into a bulb-tube of particular form, and then allowed to mix with excess of the hypobromite solution. The reaction is complete in from ten to fifteen minutes in the cold, but on warming is complete in five minutes. The apparatus is so constructed as to permit the collecting of the evolved nitrogen in a tube which is graduated in such a manner that the amount of gas read off gives at once the percentage of urea in the urine employed. A remarkable fact observed by the authors is that in the reaction between urea and the hypobromite there is invariably eight per cent. less nitrogen evolved than that required by theory. With uric acid 35 per cent. of the nitrogen is suppressed, with hippuric acid $82\frac{1}{2}$ per cent., and with creatinine 25 per cent.—The concluding paper is on Dendritic spots in paper, by Huskisson Adrian.

THE *Scottish Naturalist* for October contains the following articles:—On the Salmonidæ of the Eden, Fife, by P. Walker, F.G.S.E.—Notes on the entomology of Shetland, by the Rev. J. Blackburn and C. E. Lilley.—Concerning aquaria, by Dr. Peter White.—Tenthredinidæ in Rannoch, by P. Cameron.—Notes on Lepidoptera in Kirkcudbrightshire, by W. D. Robinson Douglas.—The occurrence of rare birds in the Carse of Gowrie, by Col. Drummond Hay.—Several articles on the fungi of Scotland, and a continuation of the lists of Scottish insects, by F. Buchanan White, M.D., and D. Sharp, M.B.

THE *Bulletin de la Société d'Acclimatation de Paris* for June opens with a paper by M. Ch. le Doux, on the yield of the cocoons of the new silkworm *Attacus aurota*, and on the best mode of winding the cocoons which are pierced by the moth on its escape, or left unfinished by the silkworm.—M. P. Chappellier gives an interesting account of the growth and preparation of saffron, with special reference to the production of new species of crocus and other saffron yielding plants in France.—The East Indian possessions of Holland, Java, Sumatra, Borneo, the Moluccas, and other islands, are the subject of a paper by M. E. Prillieux, who gives a valuable list of their principal productions, industrial and otherwise. This list includes no less than 247 timber-producing plants grown in the East Indies.—Among fishery questions perhaps no subject is of more importance than the effect produced by the use of fixed engines. Contributions to the literature on this point are made by M. Renibaud in a letter addressed to the Minister of Marine, and by Dr. Turrel, delegate of the society at Toulon.—M. Delidon continues his researches on the change of colour in the silk produced by silkworms, caused by a change of food.—M. Kemmerer, the inventor of cemented tiles for catching oyster-spat, announces that he has relinquished his patent rights in the invention which has been so successfully adopted by oyster-culturists.—The Minutes of the monthly meeting of the society, detailing the various experiments made by its members, are very interesting, including observations on many diverse subjects.—The Agricultural Society of France has offered a prize of 1,000 francs each for the best method of artificial irrigation, for the best means of destroying the *Phylloxera vastatrix*, for the best economical means of utilising the beetroot and its products, for the best horse-breeding establishment in Finistère, Côtes-du-Nord, Morbihan, Ille-et-Villaine, and Loire Inférieure, and for the educational establishment which shall have taken the best means to instruct in agriculture and horticulture.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Sept. 1.—In a former number of this periodical an instrument called the nephoscope was described by Herr Braun, intended to serve for measurement of the direction and apparent velocity of clouds. He has now made an addition to the nephoscope, by which the absolute height of clouds may be determined without any calculation, and thence also their absolute velocity. Such an instrument has been wanting in meteorology, and will certainly be useful. Of course the cloud chosen for measurement must be isolated and not very high, and the place of operation must be elevated and so placed as to command a view of the cloud's shadow. It is the height of the cloud above its shadow, not above the place of observation, which is obtained. The old method may still be followed with the nephoscope, but it is more laborious. The instrument is minutely described with reference to an annexed woodcut.—Among the *Kleinere Mittheilungen* we have a notice of Prof. Lommel's book, "Wind und Wetter." His explanation of the curves of storms issuing from the region of trade winds is somewhat as follows:—The rotation of the cyclone being in the N.E. trade wind from N. through W. and S. to E., the N.E. trade wind opposes and retards the S.E. portion, but accelerates the N.W. portion of the whirl. Thus the pressure will be least in the N.W., greatest in the S.E. quarter, and progress will be made towards the N.W. Arrived in the region of variable winds, the course will be changed according to the direction of the prevailing wind. Supposing a storm to be on the western coasts of Europe, and the most common wind, S.W., to be blowing, the direction of progress will be E. or E.S.E., and this is actually the course commonly taken by European storms.

Memorie della Societa degli Spettroscopisti Italiani, July.—This number contains an announcement of the death of Paolo Rosa at Rome on the 11th of July, and a short statement of his scientific labours; it also contains a letter from P. Rosa on the connection of solar activity and rainfall, and a paper by the same author on the identity of photospheric and magnetic phenomena in connection with the proper motion of the sun. Tables are given showing a corresponding variation of the magnetic variation with the changes in the solar diameter, there being an 11-year period of both, and also a secular period of $66\frac{2}{3}$ years. Secchi writes that the spectrum of Coggia's comet corresponded with that of a hydrocarbon, and that the continuous spectrum observed therewith was due to reflected sunlight, since it disappeared on interposing a Nicol's prism. Prof. Bredichin fixes the lines at 5633, 5164, and 4742 of Angström's scale; and Tacchini at 6770, 5620, 5110, and 4800; the longest was 5620, and the brightest 5110. The chromosphere as seen in January last is shown in a drawing by Tacchini, and he adds that he has seen the chromosphere steadily at an altitude of 3° from the horizon, and when the limb of the sun was very unsteady in a simple telescope.—Tacchini sends a note that four bolides travelling together entered our atmosphere on the 27th of July, the position and drawing is given; they were seen for 40 seconds.—A number of drawings of Coggia's comet are sent by Tacchini, with a descriptive statement. Wright adds a note that the comet's light was polarised.

Journal de Physique, tome iii., Nos. 29, 30.—In these two numbers is an article by M. Berthelot on the principles of Thermo-chemistry. The study of the evolution of heat in chemical combinations is a new branch of science belonging partly to physics and partly to chemistry, and the number of facts already observed is sufficiently numerous to indicate certain laws which M. Berthelot proceeds to set forth. It is, he premises, admitted that in a chemical combination the molecules hit sharply one against another and give off heat, just as when a hammer strikes a bar of iron. From a study of the relations between the amount of heat evolved and the amount of work done, it is possible to establish some theorems of Thermo-chemistry. 1. First principle. The amount of heat given off in any reaction is a measure of the chemical or physical work done in that reaction. Several examples are given. 35·5 grs. of chlorine unite with 1 gr. of hydrogen and form hydrochloric acid, giving off 22 calories. The compound occupies the same volume as its component parts. Here the physical work is *nil* and the chemical is 22 E (E being the mechanical equivalent of heat.) Again, 8 grs. of O unite with 1 of H to form water. At ordinary temperatures the heat evolved is 34·5 calories. But there is a change from gas to liquid. Part of the work is chemical, part physical. It is shown, then, that the temperature affects the amount of heat evolved; this is due to the physical work of exterior pressure. All computations should, when possible, be made with both the components and the compound in the state of gas. This is not always possible; hence the importance of the second principle. 2. If a system of simple or compound bodies taken in certain conditions lead to physical or chemical changes which bring about a fresh state without giving rise to any mechanical result, then the heat given off or absorbed by these changes depends entirely on the

first and last conditions of the system. The intermediate states do not affect it. For example: $C+O_2=CO_2$ gives 47 calories. Or, $C+O=CO$ gives 34·5; and then, $CO+O=CO_2$ gives 12·5, and 34·5 + 12·5 = 47 as before. We have not space to notice the five "consequences" from this principle. 3. Third principle. Every chemical change effected without the intervention of any external energy leads to the production of a body, or system of bodies, which give off more heat. For example: $Sn+O=SnO$ gives off in formation 36·9 Cal.; $Sn+O^2=SnO_2$ gives 72·7. Some compounds cannot be formed by their own energy—*e.g.* acetylene is formed by the union of C and H, but it requires the energy of an electric current to induce it.—M. Laurent describes a new saccharometer.—M. Mascart contributes an article on the annealing of glass, having special reference to the preparation of objectives.—M. Blavier's paper, continued from No. 28, is concluded.—M. Marcy describes a new chronograph of a small size convenient for holding in the hand, based on the principle of Duhamel's.—There is also an article by M. Thurot on Galileo's experiments on weight.

Annali di Chimica applicata alla Medicina, No. 2, vol. lix., August.—The present number begins with a paper in pharmacy On the reactions of morphine, from researches by Hermann, Kelbrunser, Siebold, and Schneider.—In dietetics, Prof. Fr. Selmi contributes a paper entitled "New Study of Milk," and there is also one by Dr. Martin on *koumiss*, a vinous liquid obtained by the fermentation of milk.—In toxicology there is a paper by Pietro Albertoni and Filippo Lussana on the physiological criterion for medico-legal proofs of poisoning.—In physiology, Prof. G. See furnishes a paper on the action of the salts of potassium.—Under "Varieties" there are the following papers:—On the culture of *Eucalyptus globulus*, by Dr. Ledeganck.—The blue colour of linen used for medical purposes, by Louquet.—Use of chloroform and ether for stupefying bees, by Chairon.—Phenol-camphorated oil for the gummy disease of fruits, by Dr. F. F. Adorni.—Bisulphite of soda as an antichlore for bleaching, by Dr. T. Schuchardt.—The part concludes with a biological notice of Justus Liebig, by G. Ruspini, and a review of the fourth part of the *Annuaris delle Scienze Mediche*, published by Drs. P. Schivardi and G. Pini.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences, April 7.—Dr. Jos. Leidy in the chair.—"The Blue Gravel of California," by E. Goldsmith. Under the name of "Blue Gravel" the California gold miners, and especially the placer miners, understand a rock which underlies the gold-bearing alluvium of that State and part of Nevada. It is stated that whenever the gold-bearing sand in many localities in the two above-named States has been removed by the well-known washing process, the "blue gravel" appears. It also contains gold, which cannot, however, be extracted by washing, the stream of water being unable to disintegrate the rock, which is a compact composite one, and not, as the name "gravel" would imply, a loose material. This so-called "blue gravel" is composed of two ingredients widely differing in age, namely, of pebbles cemented together by a lava. The pebbles are of all sizes. From the general appearance I infer that some of these pebbles were derived from the sedimentary rock, slate, and others from hornblende rock. Entirely different in general aspect from the rounded pebbles is the other part of the rock, which I have already stated to be a lava. This appears to envelop the pebbles completely. This lava is very brittle, so much so that the preparation of a thin plate for microscopical observation is impossible. The hardness is equal to apatite. The most distinguishing crystallisation within the lava mass is a black mica, which is probably biotite. I noticed also a few grains of quartz, as well as flattened grains of bright yellow gold. The conclusion at which I arrive is that the so-called "blue gravel" of California is a conglomerate of pebbles of various kinds cemented together by an acidic lava in which crystals of mica (biotite) and grains of gold are imbedded. How the gold came into the lava is a question of some difficulty. Whether it was mingled with the pebbles before the lava ran over the bed, or whether the gold was ejected from the volcano, I am not able to decide.

April 14.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy called attention to the "Bulletin of the United States Geological and Geographical Survey of the Territories, No. 2," presented this evening. It contains a "Review of the Vertebrata of the Cretaceous Period found west of the Mississippi River," by Prof. Cope. In this article he was quoted in such a way as not fairly to express his original meaning. Thus, on one page reference is made to the proceedings of this Academy, in which it is intimated that *Thespesius occidentalis* was referred to the Mammalia, and regarded, perhaps, as a Dinosaurian. "In the Proceedings I have rather expressed the reverse, as I state of *T. occidentalis*, among the collection of vertebrate remains, are two apparent caudal vertebræ and a first phalanx of some huge animal, which I suspect to be a Dinosaurian, though they may have belonged to a mammalian. I may add that Prof. Cope, quoting from the same Proceedings, indicated that I had referred Ischyrotherium to a Sirenian. This is so, but Prof. Cope appears to have overlooked the more full account of the animal in the Trans. of the Am. Phil. Soc., in which, though I still refer it with doubt to the mammalia sirenia, I state that the remains may have belonged to an aquatic reptile."

May 12.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy gave a notice of some new freshwater Rhizopods, having all the essential characters of Amœba, but, in addition, provided with tufts of tail-like appendages or rays, from which he proposed to name the genus Ouramœba. It is possible that Ouramœba is the same as the Plagiophrys of Claparede, though the description of this does not apply to that.—Dr. Chapman made the following remarks on the generative apparatus of the *Tebenophorus carolinensis*:—He found both ova and spermatozoa in the organ regarded first as simply the ovary, later as the testicle.

May 19.—Dr. Kenderdine in the chair.—"The Veins of Beech and Hornbean Leaves." Mr. Thomas Meehan said that De Candolle had noticed some years since a difference in the venation between the *Fagus ferruginea* and *Fagus sylvatica*, the common American and European beeches. In the American beech the lateral veins were said to terminate in the apex of the serratures, in the European they terminate at the base of the sinus. As the statement stood, it conveyed the idea that there was a marked difference in structure between these two allied species, which did not, however, exist, as growing in this country the leaves of the European beech are almost entire; the lateral veins, in approaching the margin of the leaves, curve upwards, and connect with the lateral above them, forming a sort of marginal vein near the outer edge of the leaf. The veins of the American beech curve upward in the same way, but are easily arrested, and this sudden cessation of growth produces the serra, which are slightly curved upwards.—"Direct Growth Force." Mr. Meehan referred to some potatoes exhibited by him to the Academy a few years ago, in which the stolons of a grass had penetrated through from one side to the other, preferring, as it would seem, to go through such an obstruction to turning aside to avoid it. A potato was a rather rough-surfaced body. He now exhibited a similar case, only the obstruction was the round smooth root of an herbaceous peony. Though not more than one-third of an inch thick and round, a stolon of *Triticum repens*, the common couch grass, had pushed itself through.

May 26.—Dr. Ruschenberger, president, in the chair.—On report of the committee to which it had been referred, the following paper was ordered to be published:—"Description of two new fossil shells of the Upper Amazon," by T. A. Conrad.

CONTENTS

PAGE

DIARY OF SOCIETIES.

LONDON

FRIDAY, OCTOBER 9.

JUNIOR PHILOSOPHICAL SOCIETY, at 7.30.—Introductory Address by the President.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and FLESH-FORMING QUALITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading. Price 6*d.* per month, or 5*s.* per annum, post-free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOIL, by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any **IMITATION YET** offered to the public. **It is solid, durable, and cheap, retaining to the last** its 18c. gold appearance, which cannot be detected.

CASH PRICES.

WATCHES, 25*s.* to 45*s.* Alberts, 2*s.* to 5*s.*; Long Chains, 5*s.* to 8*s.* 6*d.*; Lockets, 2*s.* to 5*s.* 6*d.*; Crosses, 1*s.* 6*d.* to 4*s.* 6*d.*; Ladies' Gem Rings, 2*s.* to 5*s.*; Wedding and Keeper Rings, 1*s.* to 2*s.* 6*d.*; Gents' Finger Rings, 2*s.* 6*d.* to 6*s.*; Bracelets, 5*s* to 10*s.* 6*d.*: Studs, 1*s.* to 3*s.* 6*d.*; Links, 1*s.* to 3*s.*; Breast Pins, 1*s.* to 4*s.* 6*d*; Brooches, 1*s.* 6*d.* to 7*s.* 6*d.*; Ear Rings, 1*s.* 6*d.* to 6*s.* 6*d.*: Sets (*en suite*), Brooch and Ear Rings, 5*s.* 6*d.* to 10*s.* 6*d.*; Pencil Cases, 2*s.* to 4*s* 6*d.*; Gents' Snake Rings (Plain Head), 3*s.* 6*d.*, Head set with Brilliant, &c., 5*s.*

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years. Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "**MAZELINE**" **GOLD JEWELLERY** to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P.O.O. to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

Price 14*s.*, with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & C-

BRYANT & MAY'S MATCHES.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests, Subscription, 16*s.* 6*d.* per annum, post free, dating from any quarter-day. Single Copies, 1*s.* each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

HOLLOWAY'S PILLS.—For the cure of bilious complaints, indigestion, and affections of the liver. Symptoms indicative of these disorders are a feeling of nausea, distention and spasmodic pains in the stomach, sense of oppression and sinking after eating, want of appetite, languor, dejection of spirits, and general debility. The removal of the cause is the most important step, for which have recourse to Holloway's Pills, as they possess such clean-ing properties that the action of the liver is speedily corrected, the redundancy of bile carried off, the stomach strengthened, the spirits revived, and patient restored. These excellent Pills keep all the natural functions so fairly balanced that they prevent or speedily subdue headache, dizziness, bilious attacks, and similar maladies

EDUCATIONAL WORKS.

SCIENCE PRIMERS.

UNDER THE JOINT EDITORSHIP OF

PROFESSORS HUXLEY, ROSCOE, AND BALFOUR STEWART.

"They are wonderfully clear and lucid in their instruction, simple in style, and admirable in plan."—*Educational Times.*

The following are Now Ready:—

CHEMISTRY. By H. E. Roscoe, F.R.S., Professor of Chemistry in Owens College, Manchester. Third Edition. 18mo, cloth, illustrated, 1*s.*

PHYSICS. By Balfour Stewart, F.R.S., Professor of Natural Philosophy in Owens College, Manchester. Second Edition. 18mo, cloth, illustrated, 1*s*

PHYSICAL GEOGRAPHY. By A. Geikie, F.R.S., Murchison Professor of Geology and Mineralogy at Edinburgh. Second Edition. 18mo, cloth, illustrated, 1*s.*

GEOLOGY. By Professor Geikie, F.R.S. With numerous Illustrations. 18mo, cloth, 1*s.*

PHYSIOLOGY. By Michael Foster, M.D. F.R.S. With numerous Illustrations. 18mo, 1*s.*

SCIENCE CLASS-BOOKS.

ANATOMY.—ELEMENTARY LESSONS in ANATOMY. By ST. GEORGE MIVART, F.R.S. With numerous Illustrations. 18mo, 6*s.* 6*d.*

ASTRONOMY.—POPULAR ASTRONOMY. With Illustrations. By Sir G. B. AIRY, Astronomer-Royal. New Edition. 18mo, 4*s.* 6*d.*

ASTRONOMY.—ELEMENTARY LESSONS in ASTRONOMY. With Illustrations. By J. NORMAN LOCKYER, F.R.S. With Coloured Diagram of the Spectra of the Sun, Stars, and Nebulæ. New Edition. 18mo, 5*s.* 6*d.*—QUESTIONS on the SAME, 1*s.* 6*d.*

BOTANY.—LESSONS in ELEMENTARY BOTANY. With Illustrations. By Prof. OLIVER, F.R.S. F.L.S. New Edition. 18mo, 4*s.* 6*d.*

CHEMISTRY.—LESSONS in ELEMENTARY CHEMISTRY. By Professor ROSCOE, F.R.S. With numerous Illustrations and Chromo-lithographs of the Solar Spectra. New Edition. 18mo, 4*s.* 6*d.*

CHEMISTRY.—OWENS COLLEGE JUNIOR COURSE of PRACTICAL CHEMISTRY. By F. JONES. With Preface by Professor ROSCOE. New Edition. 18mo, 2*s.* 6*d.*

LOGIC.—ELEMENTARY LESSONS in LOGIC, DEDUCTIVE and INDUCTIVE. By Professor JEVONS, F.R.S. With copious Questions and Examples, and a Vocabulary of Logical Terms. New Edition. 18mo, 3*s.* 6*d.*

PHYSIOLOGY.—LESSONS in ELEMENTARY PHYSIOLOGY. With numerous Illustrations. By Professor HUXLEY, F.R.S. New Edition. 18mo, 4*s.* 6*d.*—QUESTIONS on the SAME, 1*s.* 6*d.*

POLITICAL ECONOMY.—POLITICAL ECONOMY for BEGINNERS. By MILLICENT GARRETT FAWCETT. With Questions. New Edition. 18mo, 2*s.* 6*d.*

PHYSICS.—LESSONS in ELEMENTARY PHYSICS. By BALFOUR STEWART, F.R.S., Professor of Natural Philosophy in Owens College, Manchester. With Coloured Diagram and numerous Illustrations. New Edition. 18mo, 4*s.* 6*d.*

STEAM.—An ELEMENTARY TREATISE on STEAM. By J. PERRY, B.E., Whitworth Scholar, late Lecturer in Physics at Clifton College. With Illustrations, Numerical Examples, and Exercises. 18mo, 4*s.* 6*d.*

*** *Others to follow.*

BY THE REV. BARNARD SMITH, M.A.

ARITHMETIC and ALGEBRA. Twelfth Edition. Crown 8vo, cloth, 10*s.* 6*d.*

ARITHMETIC for the USE of SCHOOLS. New Edition. Crown 8vo, 4*s.* 6*d.*—KEY, 8*s.* 6*d.*

EXERCISES in ARITHMETIC. With ANSWERS. Crown 8vo, limp cloth, 2*s.* 6*d.* Separately, Part I., 1*s.*; Part II., 1*s.*—ANSWERS, 6*d.*

SHILLING BOOK of ARITHMETIC. For National and Elementary Schools. 18mo. Or separately, Part I., 2*d.*; Part II., 3*d.*; Part III., 7*d.* With ANSWERS, 18mo, 1*s.* 6*d.*—KEY, 4*s.* 6*d.*

EXAMINATION PAPERS in ARITHMETIC. In Four Parts. New Edition. 18mo, 1*s.* 6*d.* Ditto, with ANSWERS, 18mo, 1*s.* 9*d.*—KEY, 18mo, 4*s.* 6*d.*

SCHOOL CLASS-BOOK of ARITHMETIC. 18mo, 3*s.* Or Parts I. and II., 10*d.* each, and Part III., 1*s.*—KEY, complete, 18mo, 6*s.* 6*d.*; or Three Parts, 2*s.* 6*d.* each.

THE METRIC SYSTEM of ARITHMETIC: its Principles and Application. With numerous Examples. Written expressly for Standard V. in National Schools. Fourth Edition. 18mo, cloth, sewed, 3*d.*

A CHART of the METRIC SYSTEM, for School Walls. On Roller, 1*s.* 6*d.*; on Roller, mounted and varnished, 3*s.* 6*d.* Third Edition. With a full-length METRE MEASURE, subdivided into Decimètres, Centimètres, and Millimètres

Also, a SMALL CHART, on Card. 1*d.*

EASY LESSONS in ARITHMETIC. Combining Exercises in Reading, Writing, Spelling, and Dictation. Part. I. for Standard I. in National Schools. Crown 8vo, cloth, sewed, 9*d.*

DIAGRAMS for SCHOOL WALLS in preparation.

BY I. TODHUNTER, M.A. F.R.S.

EUCLID for COLLEGES and SCHOOLS. New Edition. 18mo, 3*s.* 6*d.*

MENSURATION for BEGINNERS. With Examples. New Edition. 18mo, 2*s.* 6*d.*

ALGEBRA for BEGINNERS. With numerous Examples. New Edition. 18mo, 2*s.* 6*d.*—KEY, 6*s.* 6*d.*

TRIGONOMETRY for BEGINNERS. With numerous Examples. New Edition. 18mo, 2*s.* 6*d.*—KEY, 8*s.* 6*d.*

MECHANICS for BEGINNERS. With numerous Examples. New Edition. 18mo, 4*s.* 6*d.*

ALGEBRA for the USE of COLLEGES and SCHOOLS. Sixth Edition. Crown 8vo, 7*s.* 6*d.*—KEY, 10*s.* 6*d.*

An ELEMENTARY TREATISE on the THEORY of EQUATIONS. Second Edition, revised. Crown 8vo, 7*s.* 6*d.*

PLANE TRIGONOMETRY. Fourth Edition. Crown 8vo, 5*s.*

A TREATISE on SPHERICAL TRIGONOMETRY. Third Edition. Crown 8vo, 4*s.* 6*d.*

A TREATISE on CONIC SECTIONS. With Examples. Fifth Edition. Crown 8vo, 7*s.* 6*d.*

A TREATISE on the DIFFERENTIAL CALCULUS. With Examples. Sixth Edition. Crown 8vo, 10*s.* 6*d.*

MACMILLAN & CO., LONDON.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & CO., at the Office, 21, Astor Place, New York.—THURSDAY, October 8, 1874.